THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 28. Thursday, August 9th, 1923. No. 364.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
BESSEMER HOUSE, 5, DUKE STREET, ADELPHI,
LONDON, W.C.2.

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE
INSTITUTE OF BRITISH FOUNDRYMEN AND THE
WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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British Malleable Iron.

"Give a dog a bad name, and hang it," is a proverb which is equally applicable to men and material on the down grade, and after the repeated denunciation of British malleable cast iron one is inclined to wonder whether the industry is really in a parlous condition. If not proverbial, it is at least axiomatic that if one repeats a phrase sufficiently often it becomes acknowledged as the real truth, and in this respect it becomes almost nauseating for us to print the continued eulogies of American malleable cast iron. A close examination of the question would undoubtedly reveal that the British malleable is not so bad as it is painted, nor the American so good, but much good would be done if one could find out the exact position of the British material, as that of the American is fairly well known through the publications made by their research organisation.

Unfortunately, the only method of comparison is that of tensile test, which only has reference to the material from which the castings are made. Machinability and soundness, which are equally important, are not yet standardised. In respect to tensile we believe the average maximum stress obtained from British malleable iron to be round about 22 tons per sq. in., associated with 10 per cent. elongation. Tests as high as 30 tons, associated with 7 per cent. elongation on 2 in., are not unusual, and, providing they machine well and are free from casting defects, such a test would indicate a material suitable for many engineering purposes at present being met by other materials. Assuming other conditions equal, it would appear that the British material has something like 15 to 25 per cent. improvement to make to reach the American standard. The question arises as to how this percentage is to be made up. Can firms accomplish it by individual effort, or must it be by a co-operative movement? If the latter, there is the machinery of the British Cast-Iron Research Association at hand. If the former, one would suggest that a careful examination of the raw material, melting conditions, and especially a study of annealing operations, would give the desired results. Surely it should not be difficult to reproduce on a comparatively small scale in British foundries a material regularly obtained in the States by quantity production methods. How the Americans accomplish their results has been explained in detail by Schwartz and Moldenke and Touceda, and it is open to the British to exploit their methods. The plant employed is of a simple and yet efficient character, and it would probably be a paying proposition to install new plant for many foundries, even though better tensiles were not forthcoming—that is, merely from the saving on the coal bill. It is to be hoped that conditions will be proved to be so changed in the near future that foundrymen and engineers will cease to prate with parrot-like regularity of the virtues of American and the vices of British malleable cast iron.

British Industries Fair, 1924: Change of Date.—This fair, organised by the Department of Overseas Trade, will be held at the White City, Shepherd's Bush, London, from April 28 to May 9 next year. The date has been altered to suit the convenience of over-sea buyers. The Birmingham Section of the Fair will open on the Monday (May 12) following the close of the Fair in London, and remain open till May 23. Further particulars may be obtained from the Secretary, 35, Old Queen Street, London, S.W.1.

Luxemburg Iron and Steel Industry.—Reports from Luxemburg as to the conditions and prospects of the iron industry are most gloomy. The claim is made that, as a result of the occupation of the Ruhr, Luxemburg iron and steel interests have suffered more than any other. On the other hand, Belgian interests are said to have actually benefited by reason of the fact that the Belgian coal interests have been able to increase their own output of coke while, at the same time, they have cancelled contracts for coke with the Luxemburg iron and steel plants. In Luxemburg practically all the 47 blast furnaces have been put out of action. Some coke was received from Holland and a small amount from this country, but the supplies have been too small to be of much benefit, and the prices demanded for coke now vary so much that it is difficult, if not impossible, to forecast costs in such a way as to make contracts for deliveries in the future reasonably safe.

Plate Moulding.*

By W. H. Cook, M.I.Mech.E., M.I.Brit.F.

During recent years a much greater interest has been taken in the foundry side of engineering than was formerly the case, with the result that a much better understanding now exists between the foundry and the other departments.

It is, however, surprising what an amount of ignorance still exists in regard to the best methods to follow in the production of clean, sound castings true to pattern, and also in regard to the design and finish of the pattern from which the castings are to be made.

Probably the method of producing castings by means of patterns mounted on plates is the least understood, and when asked to give a Paper on this subject, the author felt that it was his duty to do so, and to give as fully as possible the results obtained during a long experience of this system.

As to when and by whom plate moulding was first introduced, it is difficult to say, but when the author was apprenticed to Messrs. Taylor Lang & Company, Limited, Stalybridge, in 1875, a highly-organised system of plate moulding was in use.

There can be no doubt that the method was devised by someone connected with the textile machinery branch of engineering, as this branch has always been ahead of all others in the production of light and medium-size castings of a sound, clean character at a low price.

In 1900 the total labour cost, including foreman, was 1s. 4½d. per cwt. on an output of 100 to 120 tons per week taken over twelve months, a cost impossible to obtain except by the methods to be described later.

Plate moulding can be adopted for the majority of castings. We have been using for years plates as large as 8 ft. square; there are, of course, exceptions to every rule, but it is intended to refer only to the production of castings suitable for boxes which can be handled by one man with ease, and to leave out the heavier sizes.

Size of Box.

In introducing plate moulding for the class of castings under review, the size of box to be adopted is the first thing to be determined.

It is not wise to have boxes either too large or too small; if they are too heavy, the workman becomes fatigued by handling them, with a consequent loss of output; if they are too small, the output again suffers.

The following are the extreme sizes recommended:—

18 in. x 12 in. x 3 in. x 3 in.
16 in. x 12 in. x 4 in. x 4 in. or 3 in. x 3 in.
14 in. x 12 in. x 4 in. x 4 in. or 3 in. x 3 in.
12 in. x 12 in. x 6 in. x 6 in.

The 16 in. × 12 in. is probably the best size for both 3 in. and 4 in. top and bottom parts, and is most generally suitable for the patterns to be used.

The number and diameter of the pins in the boxes are a matter of opinion; for the above sizes only two pins, ¾-in. diameter are recommended.

Construction of Pattern.

It is recommended that all patterns possible be made so that they will part across a dividing line—in practically all patterns there is such a line; in a symmetrical pattern this is across the centre, as shown by the plate for the various parts of a locomotive whistle stand pattern (Fig. 1). In other cases, it is away from the centre, as shown by the cover pattern (Fig. 2), whilst in some the line will be irregular.

The cost of making patterns in this way is no more than if they are made solid, and, even if they are to be used as loose patterns, the advantages are great. The moulder, with both large and small patterns can put one-half of the pattern on a flat board or plate and ram up the bottom box; then turn it over and place the other half of pattern in position, then ram up the top box; this saves all the trouble and loss of time in making "odd sides" and reduces the risk of dirty castings through loose sand.

Whatever may be the cost of altering patterns to the style recommended, it can almost always be more than covered by reduction in labour cost, not only in the foundry, but in the after processes; and, in many instances, it will be found that substantial reductions in weight can be made, particularly in old established shops, without sacrificing any strength. In fact, saving in weight is always possible, because, in the old days when castings were cheap, weight did not matter so much.

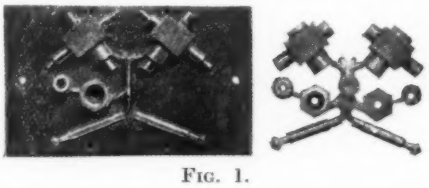

Fig. 1.

When patterns are to be used for plate work, it is usual to make them in brass, cast iron or some of the hard white metals. Cast iron is preferable, as it seems to wear better and to draw from the sand in an easier manner.

Where large numbers from any particular pattern are not required, the pattern can be made in hard wood and used direct; the plate (Fig. 3) showing pump body is an instance of this. Owing to great pressure for delivery of filter water-carts at the beginning of the war, we put these on the plate temporarily, with the intention to replace later with metal patterns; they, however, worked well, and we continued to use them throughout, making 10,000 castings from them, and a man who had never been in a foundry before made sixty castings per day after a few weeks' training.

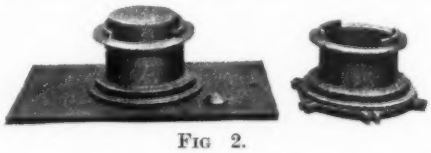

Fig 2.

The cover plate (Fig. 2) was made in "three-part" boxes, with the middle part the same depth as the space between the two flanges, the small flange being loose and lifting with the top box. We first made these loose pattern, and our most skilful moulder could only make ten per day. After putting on plate, an unskilled man made twenty-four per day, the castings being 1½ lbs. less than from the loose pattern owing to less rapping, and this at 1s. 9d. per lb. more than paid all moulding costs.

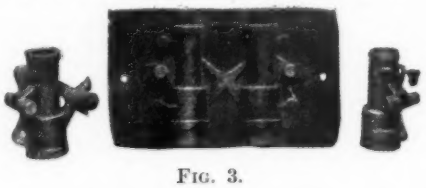

Fig. 3.

Method of Working.

We come now to a part of our subject about which there are strong differences of opinion, that is, which is the best way to work the plates—(*a*) on the bench, (*b*) on the floor, or (*c*) on a machine? Each method has its strong advocates. The author unreservedly prefers the hand-ram, self-draw machine, as we have always had at least 10 per cent. greater production from this method

* A Paper read before a recent meeting of the Manchester Association of Engineers.

than from either of the other two methods. Besides this, the castings are more exact to pattern on account of the small amount of clearance required between the pins and the holes.

Again, we are able to train men much quicker; in fact, very little training is required—a month at the most. This is a most important matter.

The foregoing is discussed because the thickness of plate depends upon which method is used. When hand-drawn, the plate must be as light as possible. Whilst some plates are not more than 5-16ths thick, they are not to be recommended less than ½ in., because the thinner plates get out of truth and also break off through "rapping."

In making plates for the machine, there is no limit to thickness—1 in. is not too great, as its weight helps to make the draw more dead, and such plates remain true and level.

Preparation of Patterns.

We have now cleared the way for preparing the patterns and mounting them on the plate.

There are differences of opinion as to the method, and in doing this, some people are in favour of cast plates, that is, plate and pattern cast together. The author prefers to mount the patterns on planed plates, and would not use a cast plate, except in cases where the patterns are such that they cannot be mounted as suggested.

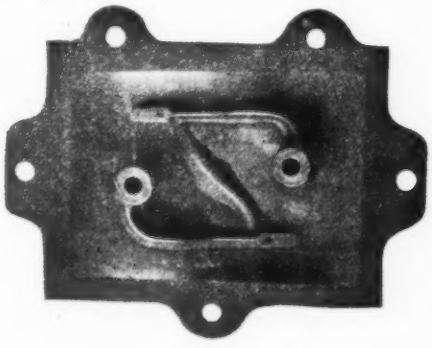

FIG. 4.

An example of a cast plate is shown in Fig. 4; the method of producing such plates is as follows:—A box much larger than the plate is used; this box has planed edge and good fitting pins. The patterns are rammed up in the bottom box, the joint being made as in loose-pattern moulding, but with much greater care; the top box is then placed in position and rammed up, lifted off, and the gates cut. A frame, the same shape as the required plate, with its centre cut away to miss the patterns, is then placed on the bottom box, sand being rammed up on the outside to a surface level with this plate; the plate and patterns are drawn, the boxes dried and cast in the usual way. To keep the boxes parallel, pieces of wood are placed at the four corners of the box.

Obviously, such a job requires great care and skill, and very few moulders have had the necessary experience.

In spite of this, it is often found the plates are not true, and to provide for this, small pieces about 1 in. sq. and ⅛ in. to 3-16 in. deep are cast at the four corners, these being chipped and filed to take out any "rock." Another fault is the tendency to twist in cooling, particularly with two-sided plates.

The best cast plates are those made by the firms engaged in the production of such goods as gas cookers, ovens and fixtures; they are very successful, and there is no other method of mounting their patterns. When the patterns are to be fixed on a planed plate, they are planed, or ground on a disc grinder on the faces of the two halves, that is, if they are of a regular shape; if they are to be planed, a piece of cardboard is glued to the joints before moulding to allow for machining; the two parts are then sweated together while being turned or filed to shape. If it is intended to fix one part of the pattern on one side of the plate and the other part on the other side, a templet hole is drilled in one part and a tapping hole in the other, the templet hole being countersunk to receive the head of the screw which is used to fix them to the plate. Further, the screw is made long enough to allow for the thickness of the plate; the patterns, after being prepared, are separated and set in position on the plate, the plate drilled and then the patterns screwed up, the screw heads being covered with solder and finished to shape of pattern. We generally arrange a clearance of ¾ in. between patterns and box edges, and fill the plate as full as possible. The gates are made to the dimensions gained from experience in loose-pattern moulding; they should, however, be kept as light as possible to save melting costs in the scrap returned to cupola.

By this method a much neater plate is obtained, which will give castings much nearer to patterns, and at no greater cost than a cast plate.

The cover pattern-plate shows another method which is often adopted; in this case the body of the pattern is extended at the flange to allow for thickness of plate, the plate being turned out to receive it.

Another interesting plate is the one showing tin roller block; when changing this from the loose pattern to plate, we were told it would never draw, but we have never had the slightest trouble, and are getting 100 to 120 castings per day.

In the plate shown in Fig. 5, the patterns are drawn through what is called a matrix. This is the only satisfactory way in which fine pitch wheels or patterns with no taper or of long draws can be made.

The plate shows how six wheels can be cast per box, and with as much ease as any other pattern, the production being at the least 240 castings per day.

The method of making such a plate is as follows: The patterns are first made of sufficient length to produce the maximum depth of wheel required, plus the thickness of the matrix, plus, say, one inch to allow for the adjusting screws for regulating the depth of wheel. A nipple ⅜ in. dia. and ¼ in. to ⅜ in. long is turned on the bottom ends to fit into holes in the bottom plate, to which they are fixed by means of set screws screwed into tapped holes in the nipples from the opposite side of plate.

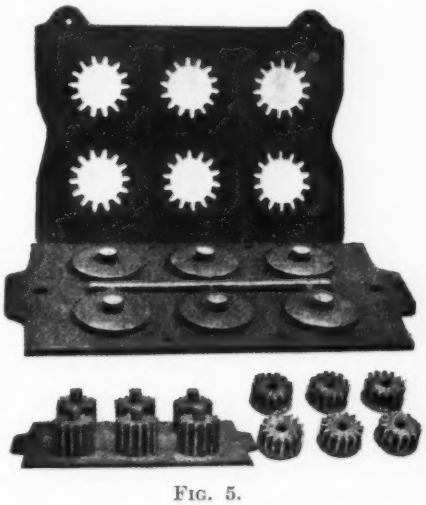

FIG. 5.

Two adjusting screws are fitted into the bottom plate, one at each end, which can be raised or lowered and locked in position to come underneath the top plate when raised for ramming, and thus regulate depth of casting.

The top plate is made one inch wider on each side than the bottom plate, to allow for fixing on the machine frame sides. The plates are then drilled to templet to receive the pins, these being fixed in the bottom plate, the top plate sliding on them.

The top plate is then set out in the following manner:—Lines are first marked out on the sides and ends at a distance of ¾ in. from the inside edges of the box; circles are then struck from the side lines with radii equal to half the outside

diameter of wheel, plus ¾ in. to allow for the matrix. The first of these centres to be in the middle of the length of plate, the other two being divided between the centre circle and the lines at the end of plate. The plates are then drilled together through these centre points the same diameter as the pivot on pattern.

The plates are then separated and the top plate turned out to the circles already mentioned; a groove about ¼ in. wide and ¼ in. deep is also turned in the middle of these holes to prevent the matrix moving up or down with the pattern. Holes ⅜ in. diameter are then drilled at three points, with the centre ½ in. from the large holes; these are cut out into the large holes to form keys into which the matrix metal runs to prevent the matrix moving in the circular direction.

All these preparations having been made, the patterns are fixed into position in the bottom plate. The top plate is next put on the pins and placed down on to the bottom plate; a mixture of 10 per cent. Cu., 10 per cent. Sb., 20 per cent. Su., and 60 per cent. Pb. is then poured round the patterns, which fills up all the spaces in top plate, and, after the two plates are separated and the matrixes turned level with the plate, all is ready for working.

Match Plates.

During later years a very clever method of mounting symmetrical patterns has been introduced. By this method only half the usual number of patterns is required—such plates are called "match" plates.

The construction of this type of plate will be readily seen from an inspection of the plate arranged for moulding the locomotive whistle stand (Fig. 1).

On examining this it will be seen that the patterns are only fixed on one side. It will be further seen that the two halves of any particular pattern are placed one on each side of horizontal and vertical lines, which are exactly central to the pins.

This may appear a difficult matter, but it is astonishing how quickly a pattern-maker will grasp the idea and be able to guarantee accuracy the first time of fixing.

Before drilling the plates the patterns are fixed in position by a coating of shellac; then a test is made. When it is found that all is in order, they are screwed to the plates and the gates fixed in position.

The gates are lighter than with double-sided plates, this being on account of them doubling themselves in the top and bottom, as seen by observing the method of using the plates, which is as follows:—The bottom box is first rammed up and laid on the floor, the top box being then rammed up from the same plate with down runner cut in it, and turned over on to the bottom box; this causes the two halves of each pattern to come together or match, and two complete sets of castings are the result, as seen by samples.

Conclusion.

(*a*). One useful arrangement in plate moulding is to bury steel bars in the floor, levelled both lengthwise and across; about two-thirds the length of box apart, 2½ in. or 3 in. T iron, is quite satisfactory.

These give a neat and perfect support to the boxes when placed on the floor.

(*b*). The boxes require to be more carefully drilled, as they must be interchangeable, but this will not add to the cost if a templet is used.

The cost of plate and mounting the patterns is the only actual increase over loose patterns, and this will be from £2 to £2 10s. each, according to number of patterns put on the plate.

Any extra cost is quickly repaid, as never less than twice the production is obtained over loose-pattern moulding. The output is often increased eight times. Again, there is a great saving in the weight of the castings, as it will be found that, with the same patterns, owing to extra rapping, castings from the loose patterns will be at the least 5 per cent. heavier than from the plate.

(*c*). The fear of a shortage of labour is removed, because what are called skilled moulders are not required, for the reason that any intelligent workman can be made efficient in a very short time.

(*d*). Another question often asked relates to the number of boxes a man should make per day.

This is a matter of coring and management, and can only be stated on seeing the job. Generally, the number may be taken from six to ten per hour.

(*e*). One point worthy of close attention is the taper in the patterns; this should be as much as possible, particularly when dealing with the insides of flanges; square corners should also be avoided wherever possible.

It is probable that all the methods described, except the "match" plates, were in use before the author was born, but he claims the privilege of trying to pass on to a younger generation his own enthusiasm in the subject, in the hope that they may have the same success in the production of both ferrous and non-ferrous castings.

In conclusion, the author desires to thank his son, Mr. W. Norman Cook, B.Sc., together with Messrs. Higginbottom, Baxter and Stead, for the great assistance they have afforded him in the preparation of this Paper.

"Moulders" of the Industry.—No. 12.

Mr. R. A. Miles, who is now President of the Lancashire Branch of the Institute of British Foundrymen, was born at Hallan Fields, Derbyshire, the village in which the Stanton Ironworks are situated. He was educated at Gorton, Manchester, and served his apprenticeship with Messrs. R. & J. Dempster, Limited, gas plant manufacturers, of Newton Heath, Manchester. After completing his indentures he gained further experience with Messrs. Craven Brothers, Galloways, Limited, and Platt Brothers, and on his 27th birthday was appointed foreman moulder with Messrs. Goddard, Massey & Warner, Limited, of Nottingham. In 1906 he was appointed foundry superintendent to

Mr. R. A. Miles.

Messrs. William Smith & Brothers, Limited, of Heywood, Lancs. During the war he became associated with the Adaptable Moulding Machine Company, of Birmingham, and later was appointed foundry manager to Messrs. Brooks & Doxey, Limited, Manchester, who at that time were making semi-steel gas shells. After the war, Mr. Miles again returned to commerce, and is now the Manchester representative for the Stanton Ironworks Company.

Mr. Miles joined the Institute of British Foundrymen in 1914, and has contributed several Papers to its Proceedings, mainly dealing with pattern mounting. After serving for several years on the local Council, he was, this year, elected to the chair of the Lancashire Branch. Mr. Miles is also a member of the Manchester Royal Exchange.

Foundry Costing.

By Thomas Bancroft.

Many firms have taken steps during the last few years to ascertain correct costs of their products, and the engineering trade as a whole have probably gone more thoroughly into the question than any other trade, but there is no doubt that the methods employed in many foundries are very crude and not much better than having no cost data at all.

As the foundry provides a large proportion of the raw material used in engineering departments, it is important that a proper method of ascertaining costs should be employed by engineering establishments having their own foundry, and more especially so where the casting is the finished product of the business.

The jobbing founder is probably more indifferent to cost of production than can be said of any other branch of the trade.

The general foundryman is guilty of relying on an "all-in" cost per ton, and by so doing is often crowded out with unprofitable orders; the profitable work in many cases is allowed to pass to competitors who have more accurately analysed their costs.

At no time in the history of commerce has it been more essential to have a correct knowledge of costs than it is to-day, on account of the general trade depression causing keener competition and smaller margins of profit.

Many business men now realise that it is much better to take orders at prices which yield no profit whatever, and thus be able to reduce their losses by having as much work as possible to take a share of the standing charges, than hold out for high prices, with the consequent result of a small turnover from which to meet those expenses that obtain whether the works are fully employed or not.

This article is therefore written with the express purpose of assisting those who have not fully recognised the importance of good costing methods in the foundry, and with a view to aiding those who may contemplate commencing such in their own works.

The best means of attaining this end is by calling in the assistance of a fully-qualified cost accountant and leave the work in his hands.

As many businesses are not large enough to employ a man in this capacity, it is only by the study of the subject that the small business can attain the desired results.

The fundamental principles advocated here are such as could be adopted by the foundry trade in general, although, as is well known, conditions vary greatly in different establishments, which may necessitate slight modifications in the methods employed to arrive at the results required. The prime object should be to determine individual costs of all castings made, and so provide the necessary means of fixing selling prices of each class of casting with a knowledge of what results can be expected.

It should be so designed as to show all leakages in labour, material and expense of whatever nature, and no doubt the detection and elimination of leakages is one of the greatest functions which a cost system should perform.

Overhead expense should be determined over a normal working period, which should not be one of short duration; six to twelve months is a suitable period on which to base such charges, and afterwards a constant check should be kept and revision made if found necessary.

A thorough study is necessary of the conditions prevailing in any establishment in which the installation of a costing system is contemplated, as this is the deciding factor as to how the required details should be ascertained.

As overhead expense is one of the greatest elements of cost of production, the activities of a business should be localised; for the sake of effective control, it is advisable to departmentalise the works in accordance with its different elements of production, and charge to each such expenses as are incurred by its existence.

Easy as it is to realise in the abstract the certainty that the different items of expense vary in their true relationship to each department, there is difficulty in arriving at the proportion of each class of expense that should be borne by each department.

There are, of course, some expenses such as supplies, wages of labourers, cupola men, etc., which can be quite easily charged to separate accounts for each department.

Other expenses of a more general character, such as supervision, clerical labour, rates and taxes, fire insurance, depreciation, etc., are not so easily allocated, and can only be charged to departmental accounts on an arbitrary basis, which should only be decided after serious consideration; later will be shown a basis on which the writer recommends such expenses should be allocated.

The elements of production can conveniently be departmentalised as follows:—(1) Melting, (2) coremaking, (3) moulding, (4) dressing.

The above classification of departments would not, of course, cover all establishments, but is sufficient for a jobbing foundry producing iron castings.

In dealing with other establishments, it may be found advisable to split the moulding department into sections in accordance with the conditions prevailing, such as machine, floor and bench moulding.

In this way all indirect expenses can be correctly allocated to each department in accordance with service rendered.

To ascertain useful costs, it is necessary that they should be made up in the following manner: Elements of cost, direct material, *i.e.*, metal in casting, direct labour, and direct on-cost.

In order to do this, it is essential that accurate records should be kept of all materials used; to record all time worked against the particular job upon which each workman is engaged, and distribute other expenses in accordance with the nearest ascertainable incidence of such expense.

As the intention here is to chiefly show how to allocate those items of expense generally known as overhead or on-cost, the writer will not attempt to show the routine by which time should be recorded against particular jobs, or how materials should be recorded, with the exception of direct materials which are shown in the cupola account, but it is essential to understand all the wages paid, and all materials used should be accounted for as direct material, *i.e.*, metal in castings, direct labour, or as on-cost.

Before proceeding to deal with that often misunderstood and wrongly-applied item of overhead or on-cost, it may be as well to explain briefly what constitutes direct material and labour.

Direct material in the foundry is the molten metal poured into the mould, or, in other words, the finished weight of the casting.

The following account will be readily understood, and will be self-explanatory to the man in the street; the writer has found it to serve best the purpose of ascertaining correct cost per ton of metal in finished product.

The reader will see at a glance that the cupola account (Table 3) shows the cost of the product of the melting department for a period of one week.

A little explanation with regard to the making up of the cupola account will prove helpful before continuing further with the subject.

The charges of each brand of pig-iron, scrap, coke and limestone put into the cupola should be weighed and entered upon a board or slate as each charge is made; in this way the materials used in the melting department are ascertained for the purpose of making up the cupola account; they are then extended at the purchase price per ton, thus showing the total cost of materials used in the cupola.

After each blow, all runners, risers, etc., are gathered together, weighed, and returned to the

cupola; the amount is then credited at the same price as scrap is charged.

Ganister being used for the purpose of lining ladles after pouring, it is correct to charge the cost of same direct to the cupola account.

Prices for pig-iron and coke are mostly quoted f.o.r. at destination; thus an extra cost is incurred for carting materials from station to works; this also is charged direct at a rate per ton of pig and coke used.

Next is added the overhead or on-cost, which is to cover such items as depreciation and repairs to melting plant, share of building occupied, share of supervision, cupola labour, etc.

The method of ascertaining the overhead charges or on-cost is shown later.

The cupola account now shows the cost of molten per ton of good castings, which forms the basis of charging direct material to the cost of all castings produced during the period.

Direct labour, or what is often termed productive labour, will perhaps be understood if described as labour spent on the formative processes, i.e., such as influences the form of the casting, as in the case of coremaking, moulding and dressing.

It will now be understood that general labouring, supervision, clerical labour, etc., constitute indirect or what is often spoken of as non-productive labour; all wages paid for this class of labour are recovered in the costs as part of the overhead charges, and wages paid for direct labour are chargeable to the particular job upon which employed.

The methods used in arriving at, and the application of the third element of cost, are chiefly responsible for the fact that few foundrymen are able to anticipate the margin of profit or loss to be expected at a given price per ton.

In order to show how the overhead or on-cast should be arrived at, a tabulated list of expenses is shown which is fairly comprehensive, and also the suggested basis for allocating expenses to each department.

After having ascertained the total amount of expense in each department, a basis of applying

Table I.—*Showing Representative List of Expenses, Basis of Allocation to Departments and Method of Calculating Metal On-cost and Departmental Hourly Burden Rates.*

Item of Expense.	Total Amount.	Basis of Allocation to Departments.	Dept. 1. Melting Dept.	Dept. 2. Coremaking Dept.	Dept. 3. Moulding Dept.	Dept. 4. Dressing Dept.
	£ s. d.		£ s. d.	£ s. d.	£ s. d.	£ s. d.
Depreciation of Buildings or amount of Rent payable.	200 0 0	In proportion to area of buildings occupied.	20 0 0	30 0 0	135 0 0	15 0 0
Rates, Taxes, Fire Insurance and Prevention.	200 0 0	do. do.	20 0 0	30 0 0	135 0 0	15 0 0
Lighting Expenses ..	60 0 0	do. do.	6 0 0	9 0 0	40 10 0	4 10 0
Building Attendance ..	60 0 0	do. do.	6 0 0	9 0 0	40 10 0	4 10 0
Depreciation of Power Transmission Plant.	50 0 0	In proportion to power consumed by each.	20 0 0	2 10 0	12 10 0	15 0 0
Power Transmission Plant Attendance.	40 0 0	do. do.	16 0 0	2 0 0	10 0 0	12 0 0
Belting, etc.	20 0 0	do. do.	8 0 0	1 0 0	5 0 0	6 0 0
Electric Current ..	100 0 0	do. do.	40 0 0	5 0 0	25 0 0	30 0 0
Depreciation of General Service Plant.	30 0 0	In proportion to service rendered.	—	6 0 0	24 0 0	—
Repairs to do.	10 0 0	do. do.	—	2 0 0	8 0 0	—
Depreciation of Cranes and Transportation Plant.	60 0 0	Fixed amount to Dept. 1 on arbitrary basis, remainder to other depts. in proportion to direct labour hours.	8 0 0	8 0 0	40 0 0	4 0 0
Repairs to do. ..	23 0 0	do. do.	3 10 0	3 0 0	15 0 0	1 10 0
Wages of Cranemen ..	175 10 0	In proportion to direct labour hours.	—	27 0 0	135 0 0	13 10 0
Depreciation of Departmental Service Plant.	150 0 0	By fixed depreciation on values.	40 0 0	15 0 0	85 0 0	10 0 0
Repairs to do.	70 0 0	do. do.	30 0 0	5 0 0	30 0 0	5 0 0
Wages of General Labourers, including Cupola Men, Pig Breaking, Stacking, etc.	1,500 0 0	Direct to dept. receiving service.	410 0 0	150 0 0	900 0 0	40 0 0
Wages for Supervision ..	350 0 0	Fixed amount to Dept. 1 on arbitrary basis, remainder to other depts. in proportion to direct labour hours.	38 0 0	48 0 0	240 0 0	24 0 0
Wages for Clerical Labour	150 0 0	do. do.	13 10 0	21 0 0	105 0 0	10 10 0
Moulding Boxes and other loose equipment.	200 0 0	Direct to dept. receiving service.	5 0 0	20 0 0	170 0 0	5 0 0
Shop supplies, such as Sand, Coke, Blacking, Plumbago, Core Oil, Chaplets, Sprigs, Brushes Riddles, Shovels, etc.	700 0 0	In accordance with departmental consumption.	5 0 0	130 0 0	555 0 0	10 0 0
Workmen's Compensation	60 0 0	In proportion to total wages of each dept.	4 10 0	7 10 0	45 0 0	3 0 0
National Insurance ..	300 0 0	In proportion to number of employees in each dept.	22 10 0	37 10 0	225 0 0	15 0 0
Works Management and Administration.	500 0 0	Fixed amount to Dept. 1 on arbitrary basis, remainder to other depts. in proportion to direct labour hours.	45 0 0	70 0 0	350 0 0	35 0 0
Commercial Expenses ..	600 0 0	do. do.	54 0 0	84 0 0	420 0 0	42 0 0
	5,608 10 0		815 0 0	722 10 0	3,750 10 0	320 10 0
Total Direct Labour Hours			—	9,000	45,000	4,500
Total Output of Good Castings.			785 tons	—	—	—
Oncost Rate, correct to the nearest penny ..			£1 0s. 9d. per ton.	1s. 7d. per hour.	1s. 8d. per hour.	1s. 5d. per hour.

XUM

June 30th, 1923.

BLAST FURNACES OF THE UNITED KINGDOM

BUILT AND IN BLAST.

Compiled from Returns Received Direct from the Furnaces, and Published at the Offices of

BESSEMER HOUSE, 5, DUKE STREET, ADELPHI, LONDON, W.C. 2
Telegrams—ZACATECAS, WESTRAND, LONDON. Telephone—GERRARD 6611 (2 Lines).

THE FOUNDRY TRADE JOURNAL, WITH WHICH IS INCORPORATED THE IRON & STEEL TRADES JOURNAL.

These Statistics have been published regularly each Quarter since 1879.

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Jno. STEVENSON, Ltd.
(Formerly JNO. STEVENSON),
MIDDLESBROUGH and Newcastle-on-Tyne.
PIG IRON. COALS. COKE.

Total number of Furnaces Built on June 30th, 1923	**488**
Total number of Furnaces in Blast on June 30th, 1923	**223**
Decrease in the number of Furnaces Built	**2**
Increase in the number of Furnaces in Blast since March 31st, 1923	**23**
Furnaces Blown-in since March 31st, 1923	**30**

Scotland (8).—Coltness Iron Co., 2; Wm. Dixon, Ltd., 2; Glasgow Iron & Steel Co., 1; Wm. Baird & Co., 3.
South Wales (3).—Baldwins, Ltd., 1; Ebbw Vale Steel Iron & Coal Co., 2.
Durham and Northumberland (1).—Dorman, Long & Co., Carlton Ironworks, 1.
Lincolnshire (3).—Appleby Iron Co., 1; Redbourn Hill Iron & Coal Co., 1; John Lysaght, Ltd., 1.
Cleveland (3).—Bolckow, Vaughan & Co., 1; Wm. Whitwell & Co., 2.
West Cumberland (1).—United Steel Companies, Ltd., 1.
South and West Yorkshire (2).—Walter Scott, Ltd., 1; Newton, Chambers & Co., 1.
Lancashire (1).—Wigan Coal & Iron Co., 1.
Derbyshire (4).—Stanton Ironworks Co., 4.
South Staffordshire, etc. (3).—N. Hingley & Sons, 1; M. & W. Grazebrook, 1; Baldwins, Ltd., 1.
North Staffordshire (1).—Goldendale Iron Co., 1.

Furnaces Blown-out since March 31st, 1923	**7**

Scotland (3).—Jas. Dunlop & Co., 1; Summerlee Iron Co., 1; David Colville & Co., 1.
South Wales (1).—Baldwins, Ltd., 1.
West Cumberland (1).—Whitehaven Hematite Iron & Steel Co., 1.
Northamptonshire (1).—Lloyds Ironstone Co., 1.
South Staffordshire, etc. (1).—G. & R. Thomas, 1.

Furnaces being built at present time (See below).	**9**

Furnaces being Re-lined at present time	**67**

Durham (6).—Consett Iron Co., Ltd., 2; Dorman, Long & Co., 1; Linthorpe-Dinsdale Smelting Co., 1; Seaton Carew Iron Co., 2.
Nottingham and Leicestershire (1).—Stanton Ironworks Co., 1.
Cleveland (15).—Bolckow, Vaughan & Co., Ltd., 8; Cargo Fleet Iron Co., 1; Wm. Whitwell & Co., 1; Dorman, Long & Co., 1; Cochrane & Co., 1; Pease & Partners, 3.
South Staffordshire (2).—Alfred Hickman, 1; G. & R. Thomas, 1.
Staffordshire, North (5).—Robert Heath & Low Moor, 2; Goldendale Iron Co., 1; Stafford Coal & Iron Co., 1; Shelton Iron, Steel & Coal Co., 1.
Cumberland (4).—United Steel Companies (Workington), 3; Millom & Askam Hematite Iron Co., 1.
North Wales (1).—Darwen & Mostyn Iron Co., 1.
Derbyshire (6).—Sheepbridge Coal & Iron Co., Ltd., 1; Clay Cross Co., 1; Denby Iron & Coal Co., 1; Stanton Ironworks Co., 2; Staveley Coal & Iron Co., 1.
Northamptonshire (4).—Kettering Iron & Coal Co., 1; New Cransley Iron Co., 1; Islip Iron Co., 1; Lloyds Ironstone Co., 1.
Lincolnshire (1).—North Lincolnshire Iron Co., Ltd., 1.
Lancashire (5).—North Lonsdale Iron & Steel Co., Ltd., 2; Barrow Hematite Steel Co., 2; Darwen & Mostyn Iron Co., 1.
Scotland (10).—James Dunlop & Co., 1; Carron Co., 1; Shotts Iron Co., 1; David Colville & Sons, 2; Coltness Iron Co., 1; Wm. Dixon, Ltd., 3; Summerlee Iron Co., 1.
South Wales (6).—Ebbw Vale Steel, Iron & Coal Co., Ltd., 2; Guest, Keen & Nettlefolds, Ltd., 2; Blaenavon Co., 1; Briton Ferry Works, Ltd., 1.
South-West Yorkshire (1).—Newton, Chambers & Co., 1.

Scotland.

Name of Firm.	Total in blast on June 30.	In blast June 30 making: Hem.	In blast June 30 making: F'gs. & F'd'y.	In blast June 30 making: Basic.	Average in blast: June qr.	Average in blast: Mch. qr.	Total built.	Fces relining
Langloan Iron and Chemical Co., Ltd., Coatbridge	—	—	—	—	—	—	5	—
Coltness Iron Co., Ltd., Coltness	4	2	2	—	4	—	9	1
Dixon, Wm., Ltd., Calder	—	—	—	—	—	—	7	1
Dixon, Wm., Ltd., Govan	4	3	1	—	4	2	6	2
Dunlop, Jas., & Co., Ltd., Tolcross	3	1	2	—	3	4	6	1
Glasgow Iron and Steel Co., Ltd., Wishaw	5	5	—	—	4	4	6	—
Merry and Cuninghame, Ltd., Carnbroe	—	—	—	—	—	—	5	—
Shotts Iron Co., Ltd.	4	—	4	—	4	4	5	1
Summerlee Iron Co., Ltd. Coatbridge	4	—	4	—	4	5	7	1
Baird, Wm., & Co., Ltd., Gartsherrie	7	4	3	—	6	6	12	—
Baird, Wm., & Co., Ltd.,	—	—	—	—	—	—	3	—

Cleveland District.

Name of Firm	Total in blast on June 30.	In blast June 30 making: Hem.	In blast June 30 making: F'gs. & F'd'y.	In blast June 30 making: Basic.	Average in blast: June qr.	Average in blast: Mch. qr.	Total built.	Fces relining
Dorman, Long & Co., Ltd., North Eastern Steel Works	2	—	2	—	2	2	4	1
Gjers, Mills & Co., Ltd.	3	3	—	—	3	3	5	—
Cargo Fleet Iron Co., Ltd.	2	—	—	2	2	2	5	1
Tees Furnace Co., Ltd., Lackenby	—	—	—	—	—	2	3	—
Bolckow, Vaughan & Co., Ltd.—								
Clay Lane	—	—	—	—				
Cleveland, South Bank	4	—	4	—	4	2½	4	2
Cleveland Steel Works, Eston	1	—	1	—	½	—	5	1
Middlesbrough								1
South Bank	*1	—	1	—	3	3½	5	1
Grangetown	—	—	—	—	—	—	6	1
Linthorpe - Dinsdale Smelting Co., Ltd. (Linthorpe Iron Works)	2	2	—	—	2	2	6	—

Northamptonshire.

Name of Firm.	Total in blast on June 30.	In blast June 30 making: Hem.	In blast June 30 making: F'gs. & F'd'y.	In blast June 30 making: Basic.	Average in blast: June quarter	Average in blast: Mch quarter	Total built.	Fces relining
New Cransley Iron Co.	1	—	1	—	1	1	2	1
Executors of P. Phipps, Hunsbury Hill Iron Works	—	—	—	—	—	—	—	—
United Steel Companies, Ltd, Wellingboro'	1	—	1	—	1	1	4	—
Islip Iron Co., Ltd., Thrapston	2	—	2	—	2	2	4	1
Kettering Iron and Coal Co., Ltd., Kettering	2	—	2	—	2	2	3	1
Wellingboro' Iron Co., Ltd., Wellingboro'	1	—	1	—	1	1	3	—
Lloyd's Ironstone Co., Ltd.	2	—	1	1	2½	3	3	1
Totals	9	—	8	1	9½	10	21	4

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Muirkirk
Baird, Wm., & Co., Ltd., Eglinton — 7 3 4 — 7 4 — 6
Baird, Wm., & Co., Ltd., Lugar — 5
Dalmellington Iron Co., Ltd., Dalmellington — — — — — — — 5 —
Merry & Cuninghame, Ltd., Ardeer — 3 — 3 — 3 3 5 —
David Colville & Sons, Ltd., Glengarnock — 4 — 4 — 4½ 5 7 2
Carron Co., Carron — 3 — 3 — 3 2½ 4 1
Totals .. .. 48 18 30 — 45½ 39½ 102 10

North Wales.

Brymbo Steel Co., Ltd.	1	—	—	1	1	1	1	—
Darwen & Mostyn Iron Co., Ltd., Mostyn	*2	—	—	—	2	2	3	1
Totals	3	—	—	1	3	3	4	1

*Two furnaces making ferro-manganese, etc.

South Wales & Mon.

Briton Ferry Works, Ltd. Briton Ferry	1	1	—	—	1	1	2	1
Baldwins, Ltd., Cwmavon Works, Glamorgan	—	—	—	—	—	—	2	—
Baldwins, Ltd., Swansea Hematite Works, Landore	—	—	—	—	1	1	2	—
Baldwins, Ltd., Margam	2	—	—	2	1	1	2	—
Crawshay Bros. (Cyfarthfa), Ltd.	—	—	—	—	—	—	5	—
Guest, Keen & Nettlefolds, Ltd., Dowlais	2	2	—	—	2	2	4	1
Guest, Keen & Nettlefolds, Ltd., Cardiff	1	1	—	—	1	1	4	1
Guest, Keen & Nettlefolds, Ltd. (Cwmbran, Mon.)	—	—	—	—	—	—	1	—
Blaenavon Co., Ltd., Blaenavon	2	2	—	—	2	2	3	1
Ebbw Vale Steel, Iron and Coal Co., Ltd.	3	2	—	1	2	—	9	2
Fyle & Blaina Works, Ltd.	—	—	—	—	—	—	2	—
Totals	11	8	—	3	10½	8	36	6

Durham and Northumberland.

Dorman, Long & Co., Ltd., Carlton Iron Works	*2	—	—	—	2	1	3	1
Dorman, Long & Co., Ltd., Clarence Works	2	—	—	2	2	2	11	—
Consett Iron Co., Ltd., Blackhill	3	3	—	—	3	3	8	2
Palmers Shipbuilding and Iron Co., Ltd., Jarrow	2	2	—	—	2	½	5	—
Linthorpe-Dinsdale Smelting Co., Ltd., Middleton	†3	—	—	—	3	2½	4	1
Seaton Carew Iron Co., Ltd., West Hartlepool	2	2	—	—	2	2½	4	2
Pease & Partners, Ltd., Tees-Bridge Iron Wks.	—	—	—	—	—	—	3	—
Weardale Steel, Coal and Coke Co., Ltd., Tudhoe Furnaces, Spennymoor	—	—	—	—	—	—	2	—
Totals	14	7	—	2	14	11½	40	6

*Two furnaces making ferro-manganese, etc.
†Three furnaces ditto.

Lincolnshire.

Appleby Iron Co., Ltd., Frodingham	4	—	—	4	4	3	4	—
Frodingham Iron and Steel Co., Ltd., Doncaster	3	—	—	3	3	3	4	—
Redbourn Hill Iron and Coal Co., Ltd.	3	—	—	3	2½	2	4	—
North Lincolnshire Iron Co., Ltd., Scunthorpe	2	—	—	2	2	—	3	1
Trent Iron Co., Ltd., Scunthorpe	2	—	—	2	2	2	3	—
John Lysaght, Ltd., Normanby Park Steelworks, Scunthorpe	5	—	2	3	4½	4	5	—
Totals	19	—	2	17	18	14	23	1

Notts. and Leicestershire.

Bestwood Coal and Iron Co., Ltd., near Nottingham	2	—	2	—	2	1½	4	—
Stanton Ironworks Co., Ltd., Ashby	3	—	3	—	3	3	4	1
Totals	5	—	5	—	5	4½	8	1

Shropshire.

Madeley Wood Co. ..	—	—	—	—	—	—	3	—
Lilleshall Co., Ltd. ..	2	—	—	2	2	1½	3	—
Totals	2	—	—	2	2	1½	6	—

Dorman, Long & Co., Ltd., Newport Ironworks — 4 2 2 — 4 3½ 7 —
Pease & Partners, Ltd., Normanby Iron Works — 2 2 — — 2 2 3 1
Cochrane & Co., Ltd. — 1 — 1 — 1 1 3 1
Dorman, Long & Co., Ltd. Redcar Ironworks — 3 — — 3 3 3 6 —
Pease & Partners, Ltd., Skinningrove — 4 — 4 — 4 4 5 1
Pease & Partners, Ltd., Tees Ironworks — 2 2 — — 2 2 3 1
W. Whitwell & Co., Ltd. — 2 2 — — 1½ — 3 1
Totals 35 13 15 5 34 32½ 73 15

NOTE:—Basic heading includes furnaces making Cleveland pig-iron for steel-making purposes.
* Two furnaces making ferro-manganese, etc.

West Cumberland.

United Steel Companies, Ltd., Harrington, Derwent Solway, Moss Bay, Workington	*7	5	—	—	6½	6½	18	3
United Steel Companies, Distington	—	—	—	—	—	—	3	—
Millom & Askam Hematite Iron Co., Ltd., Millom	3	3	—	—	3	2½	6	1
Whitehaven Hematite Iron & Steel Co., Ltd.	1	1	—	—	2	2	3	—
Totals	11	9	—	—	11½	11	30	4

* Two furnaces making ferro-manganese, etc

North Staffordshire.

Midland Coal, Coke and Iron Co., Ltd., Apedale	2	—	1	1	2	2	5	—
R. Heath & Low Moor, Ltd., Stoke	2	—	2	—	2	2	6	2
Goldendale Iron Co. ..	1	—	1	—	1	½	2	1
Stafford Coal and Iron Co., Ltd.	3	—	3	—	3	3	4	1
Shelton Iron, Steel and Coal Co., Ltd., Stoke	3	—	—	3	3	2½	4	1
Totals	11	—	7	4	11	10	21	5

South and West Yorkshire.

Walter Scott, Ltd., Leeds Steelworks	2	—	2	—	1½	2	4	—
R. Heath & Low Moor, Ltd.	*1	—	1	—	1	1	2	—
Parkgate Iron and Steel Co., Ltd.	2	—	—	2	2	2	3	—
Newton, Chambers & Co., Ltd., Sheffield	2	—	2	—	2	1	3	1
Yorks Iron and Coal Co., Ltd., Leeds	2	—	2	—	2	2	5	—
Wm. Woodhead & Son, Ltd., Bradford	—	—	—	—	—	—	1	—
Totals	9	—	7	2	8½	8	18	1

*Cold Blast.

Lancashire.

Millom & Askam Co., Ltd., Askam	—	—	—	—	—	—	1	—
Charcoal Iron Co., Ulverston (Backbarrow)	1	1	—	—	1	1	1	—
Barrow Hematite Steel Co., Ltd.	3	3	—	—	3	3	9	2
Carnforth Hematite Iron Co., Ltd., Carnforth	1	1	—	—	1	1	3	—
Darwen & Mostyn Iron Co., Ltd., Darwen	*1	—	—	—	2	1	2	1
Wigan Coal and Iron Co., Ltd.	†2	—	—	1	2	1	5	—
North Lonsdale Iron and Steel Co., Ltd.	2	2	—	—	2	2	4	2
Partington Steel & Iron Co., Ltd., Irlam, near Manchester	3	—	—	3	3	3	6	—
Totals	13	7	—	4	14	12	31	5

* One furnace making ferromanganese, etc.
†Ditto " " "

Derbyshire.

Stanton Ironworks Co., Alfreton	2	—	2	—	2	2	3	1
Butterley Co., Ltd., Alfreton (Butterley Wks.)	—	—	—	—	—	—	2	—
Clay Cross Co.	1	—	1	—	1	1	3	1
Denby Iron and Coal Co.	3	—	3	—	3	2½	4	1
E. P. Davis, Bennerley ..	1	—	1	—	1	1	3	—
Ditto, Erewash ..	—	—	—	—	—	—	2	—
Renishaw Iron Co., Ltd., Chesterfield	1	—	1	—	1	1	2	—
Sheepbridge Coal and Iron Co., Ltd.	2	—	2	—	2	2	4	1
Staveley Coal and Iron Co., Ltd., Staveley and Devonshire Works	6	—	6	—	6	6	11	1
Stanton Ironworks Co.	8	—	8	—	8	4	9	1
Totals	24	—	24	—	24	19½	43	6

South Staffordshire and Worcestershire.

T. & I. Bradley, Ltd. (Cappenfield)	—	—	—	—	—	—	2	—
Bradley & Foster, Ltd., Darlaston	—	—	—	—	—	—	2	—
G. & R. Thomas, Hatherton	—	—	—	—	1	1	2	1
Earl of Dudley, Brierley Hill	1	—	1*	—	1	1	4	—
N. Hingley & Sons, Ltd., Dudley	1	—	1	—	1	—	2	—
Alfred Hickman, Ltd. ..	4	—	—	4	4	4	5	1
Willingsworth Iron Co., Ltd., Wednesbury	—	—	—	—	—	—	2	—
M. & W. Grazebrook, Ltd., Dudley	2	—	2	—	2	1	2	—
Cochrane & Co., Dudley	—	—	—	—	—	—	2	—
Baldwins, Ltd. (Netherton Furnaces)	1	—	1	—	1	—	2	—
Wm. Roberts (Tipton), Ltd.	—	—	—	—	—	—	3	—
The Birchill's Furnaces, Ltd., Walsall	—	—	—	—	—	—	2	—
Totals	9	—	5	4	10	7	30	2

*Cold Blast

Gloucester, Somerset, and Wilts.

New Westbury Iron Co., Ltd.	—	—	—	—	—	—	2	—
Totals	—	—	—	—	—	—	2	—
GRAND TOTALS FOR UNITED KINGDOM .	223	62	103	45	222	191½	488	67

New Furnaces Building (9).

DERBYSHIRE (3):—Stanton Ironworks Co., 2; Renshaw Iron Co., Ltd., 1.
SOUTH STAFFS (2):—Bradley & Foster, Ltd., 1; T. & I. Bradley, 1.
SOUTH WALES (1):—Baldwins, Ltd., 1.
LINCOLNSHIRE (2):—Appleby Iron Co., 2.
NOTTS AND LEICESTERSHIRE (1):—Stanton Ironworks Co., Ltd. 1.

Number of Furnaces in Blast on June 30, 1923.

District.	Average in blast for Quarter.	Total in blast on June 30, 1923	Total in blast on June 30 making Hem.	Spg. & Bess.	Basic.	Ferro-Man., etc.
Scotland	46½	48	18	30	—	—
Durham and Northumberland ..	14	14	7	—	2	5
Cleveland	34	35	13	15	5	2
Northamptonshire	9½	9	—	8	1	—
Lincolnshire	18	19	—	2	17	—
Derbyshire	24	24	—	24	—	—
Notts and Leicestershire ..	5	5	—	5	—	—
S. Staffordshire & Worcestershire ..	10	9	—	5	4	—
North Staffordshire	11	11	—	7	4	—
West Cumberland	11½	11	9	—	—	2
Lancashire	14	13	7	—	4	—
South Wales	10½	11	8	—	3	—
South and West Yorkshire ..	8½	9	—	7	2	—
Shropshire	2	2	—	—	2	—
North Wales	3	3	—	—	1	2
Gloucester, Somerset, and Wilts. ..	—	—	—	—	—	—
Totals	222	223	62	103	45	13
Totals for Previous Quarter ..	191½	200	52	93	45	10

Average Number of Furnaces in Blast for the previous Six Quarters.

District.	Mar. 1923.	Dec. 1922.	Sept. 1922.	June, 1922.	March 1922.	Dec., 1921.
Scotland	50½	32	18½	12⅝	10⅜	16
Durham and Northumberland	11½	8½	8	8⅛	9⅛	9⅛
Cleveland	32½	24⅝	21	18½	17	11
Northamptonshire ..	10	9½	9	6⅜	5⅜	3⅜
Lincolnshire	14	11	9½	9	6	4
Derbyshire	10⅜	17	14½	12	12	13⅜
Notts and Leicestershire	4½	3	3	2	2	2
S. Staffordshire and Worcestershire	7	6½	6⅜	6	4⅜	3⅜
North Staffordshire ..	10	9	6	5	5	4
West Cumberland ..	11	9⅜	7	5⅜	4	3⅜
Lancashire	12	10½	7	7⅛	7	6⅜
South Wales	8	7	9½	9½	7⅛	4⅜
South and West Yorkshire	8	7	7	6	4	5
Shropshire	1½	1	1	—	—	—
North Wales	3	2	2	2	1	1
Gloucester, Somerset and Wilts.	—	—	—	—	—	—
Totals	191½	157½	130	112½	98	88½

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such expense to the departmental product is required; it will be apparent to the reader that, as molten metal is the product of the melting department, the only practical way of applying departmental expense is on the basis of an amount per ton of good castings.

It is therefore essential before a reliable rate per ton can be calculated that the number of tons of good castings produced during a normal period should be known; the total expense of the department is then divided by the tons of good castings made in the same period, the result being a correct charge rate for applying the departmental expense to the cupola account.

In the coremaking, moulding and dressing departments the direct labour hour is unquestionably the best means of applying the departmental expense to the cost of the finished product; as in the case of the melting department, a normal period should be the period from which direct labour hours are ascertained, the total expense of each department is then divided by the number of hours and a proper charge rate or hourly burden rate is the result.

It is assumed that the reader will be acquainted with the routine necessary to ascertain accurately the correct amount of each class of expense, the amount of time and wages chargeable to each job, the amount of materials consumed whether direct or indirect; therefore, on account of the varying conditions which exist in different works, the writer has not shown any such routine, as it is essential that each business should be treated on its own in this respect.

Finally is shown a complete cost of a fly-wheel casting, which will illustrate the principle on which the cost of production should be finally made up.

Table II. shows a 6-in. x 4-in. cost card, and can be conveniently filed in accordance with the class of job and method of moulding. This will permit of easy reference to any job previously made, and would prove of great assistance to the foundryman when quoting for future jobs, etc.

If the foundry trade in general would give more serious thought to this subject they would find that the advantages gained would far outweigh the little extra cost incurred in clerical labour.

TABLE 2.—*Showing Cost Card for a Fly-Wheel Casting.*

CLASS OF PATTERN USED—Strickle and Corebox. ORDER NO. 265. JOB NO. 4420.
DESCRIPTION—One 7 ft. 0 in. by 10 in. Face Flywheel Casting.

CUSTOMER—John Jones & Co., Ltd., Glasgow.

	Weight of Finished Casting.				Rate per ton.			Total cost.		
	Tons.	Cwts.	Qrs.	Lbs.	£	s.	d.	£	s.	d.
Metal	2	5	0	0	7	2	0	15	19	6
	Labour.				Oncost.					
	Hours	£	s.	d.	Hourly rate.	£	s.	d.		
Coremaking	20	1	18	0	1/7	1	11	8	3	9	8
Moulding	60	5	10	0	1/8	5	0	0	10	10	0
Dressing	10	0	14	0	1/5	0	14	2	1	8	2
Cost per ton .. £13 18 10									31	7	4

MR. F. PHILLIPS has retired from the position of joint managing director of the Park Gate Iron & Steel Company, Limited. Mr. F. Clements has been elected assistant managing director. Mr. Phillips has been associated with the company for fifty years.

MR. CHAS. WIGGINS, manager of the Middlesbrough branch of Fletcher & Son, Limited, iron and metal merchants, Leeds, has been elected an honorary life member of the North of England Association of Iron, Steel and Metal Merchants in recognition of valuable services rendered.

TABLE 3.—*Showing Cupola Account.*

	Tons.	Cwts.	Qrs.	Lbs.
WEIGHT OF GOOD CASTINGS	20	0	0	0

LARGE } CUPOLA
SMALL }

WEEK ENDED

Material.	Weight. T.	C.	Qrs.	Lbs.	Cost Per Ton. £	s.	d.	Folio	Amount. £	s.	d.	% to Total Melt.	Cost per ton of Good Castings. % of Good W'ht.	Cost per ton £	s.	d.
Pig-Iron Charged	5	—	—	—	6	0	0		30	0	0	20		1	10	0
Thorncliffe	3	15	—	—	6	5	0		23	8	9	15		1	3	5¼
Carron	—	15	—	—	6	2	6		4	11	10½	3		0	4	7
Sheepbridge	—	10	—	—	5	7	6		2	13	9	2		0	2	8¼
	10	—	—	—					60	14	4½	40		3	0	8½
Scrap Charged	15	—	—	—	4	10	0		67	10	0	60		3	7	6
Total Metal Melted	25	—	—	—					128	4	4½	100		6	8	2½
Less Scrap, Runners, Risers, etc., returned to Cupola ..	4	—	—	—	4	10	0		18	0	0			0	18	0
Fuel:—									110	4	4½			5	10	2½
Coke	3	5	—	—	2	0	0		6	10	0			0	6	6
Wastage in Weight																
Cartage—Pig-iron	10	—	—	—	0	4	0		2	0	0			0	2	0
Coke	3	5	—	—	0	5	0		0	16	3			0	0	9¾
Limestone	—	5	—	—	1	10	0		0	7	6			0	0	4½
Ganister	—	12	—	—	2	0	0		1	4	0			0	1	2½
									121	2	1½			6	1	1¼
Overheads per ton of good castings					1	0	9		20	15	0			1	0	9
									141	17	1½			7	1	10¼
Percentage of good castings to melting	80%															

An Apprenticeship Course in Foundry Practice.—LIII.

By Ben Shaw and James Edgar.

CUPOLAS AND CUPOLA CHARGING.

The most economical method of remelting the pig-iron for use in the foundry is undoubtedly by means of a cupola. Air-furnaces and, to a much lesser extent, electrical furnaces are also used, but for ordinary foundry purposes they are too costly. Both these latter types of furnaces produce cleaner iron. In neither case is the metal contaminated to a similar extent as in the cupola because the metal is not in contact with fuel. The reverberatory furnace is sometimes used for melting a special quality of cast-iron such as is desirable for conversion into malleable cast-iron, and in other cases for melting a suitable mixture for chilled castings of superior quality. The advantages of the air-furnace are due to the complete separation of the metal from the fuel which reduces the absorption of sulphur, and by this process of melting, both silicon and manganese are reduced to a greater extent than in the cupola, further it is useful when a large quantity of metal is required for one casting. It is, however, a very slow process of melting and occupies many hours. In addition it may be noted that the proportion of fuel to metal melted is usually high, in some cases consuming almost as much fuel as the amount of liquid metal produced. Thus, the fuel cost is

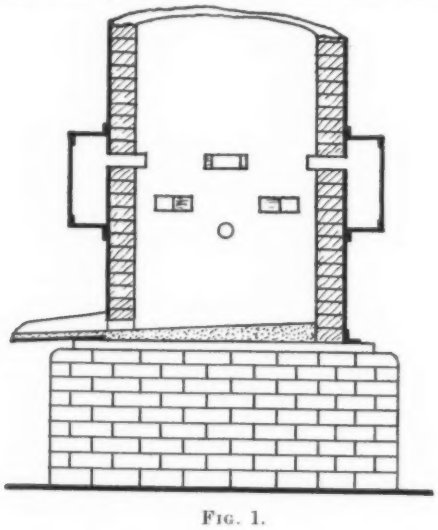

Fig. 1.

relatively high. Nevertheless, for special work of the nature already referred to, the advantages frequently compensate for the additional cost.

The electric furnace seems to offer possibilities for the remelting of pig-iron for foundry use, but although this method is in operation in America for special classes of work and to a small extent in England, the high relative cost precludes its more general adoption in this country. Given power at an economical rate, however, there is no doubt that the electric furnace would produce a better cast iron of more regular quality than is now obtained through the cupola. Use has been made of the electric furnace after the iron has been rendered fluid in the cupola to produce a more regular and better mixture, but these have been exceptional cases. Under present conditions there is little likelihood of the cupola being superseded in the iron foundry, and consequently we purpose confining ourselves in this article more particularly to this melting appliance.

The Cupola.

The cupola consists of a wrought-iron or mild steel shell of considerable height, having an air-belt surrounding it near to the bottom and lined inside with firebricks and ganister. Connecting the air-belt with the inside of the furnace are a number of tuyeres. Just beneath the tuyeres and, at any suitable position about the cylinder shell an outlet is made which is known as the slag hole. At the bottom, and at one side, is a large D-shaped aperture commonly known as the breast hole, used for firing the cupola and for making up the bottom preparatory to starting. On the opposite side, and a little above the bottom plate, to allow for a refractory bed, is the tapping hole At a considerable distance above the bottom plate, the amount varying with the inside diameter of the cupola is another large D-shaped aperture known as the charging hole. Usually a gantry or platform surrounds the furnace stack about 12 or 18 in. below the bottom of the charging hole. In the more modern cupolas some form of spark arrester is used on top of the furnace stack, although in many foundries this useful addition is not adopted. Cupolas vary very much in design, but they may be divided into three main types. These are the solid-bottom, the drop-bottom and the receiver type.

Drop and Solid-Bottom Cupolas.

The solid-bottom cupola, an illustration of which is shown in Fig. 1, has a brick foundation on

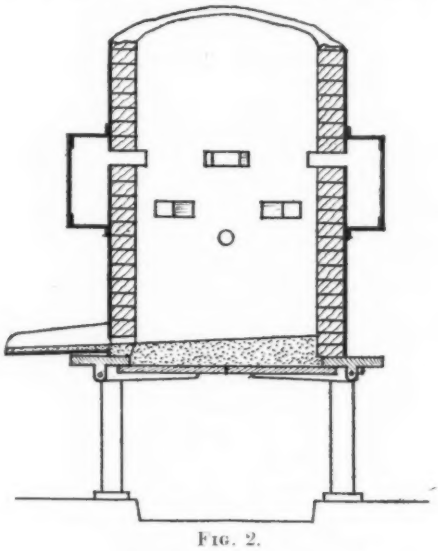

Fig. 2.

which the bottom plate rests. This is the less modern form, and is commonly associated with the average jobbing foundry. The main disadvantage of this form is experienced at the conclusion of a "blow" when the furnace is "drawn." It necessitates the breast plate being removed and the residue in the furnace being drawn through the breast hole. It must be remembered that this is done directly after the last of the metal has been tapped, and although little time is occupied in the process of drawing the unburnt coke, etc., the nature of the work can be readily imagined to be of an arduous character. The drop-bottom type of furnace is more modern than that of the solid-bottom, but of the two there is little difficulty in determining which is the better, as although the solid-bottom type has still many adherents, the drop-bottom is cleaner and, from the furnaceman's point of view, more humane. In this case, that part of the bottom plate carrying the stack, is supported on columns as in Fig. 2, but the part covering the inside diameter of the furnace is hinged. In the small furnaces this loose bottom is sometimes in one piece, but usually it is formed in two pieces. When the hinged bottom is in position, a locking device is used to maintain its position and frequently a strut is used as an additional safeguard. The bottom requires to be

XUM

carefully made up with ganister or fireclay prior to the cupola being fired. After the last of the metal has been tapped this loose bottom is dropped on its hinges and the residue drops from the furnace where it can be easily cooled and drawn from under it to be taken away. This type of furnace offers better facilities for relining because it is more accessible.

Receiver Type Cupola.

The receiver type of furnace is a comparatively recent improvement on the method of using a large ladle as a receiver. The receiver is part of the installation and has direct contact with the cupola. As the metal trickles down the furnace to the hearth, it passes into the receiver. Apart from the receiver type of cupola, all furnaces are constructed to carry a more or less quantity of fluid metal and this is tapped off at intervals according to speed of melting. Thus, all such

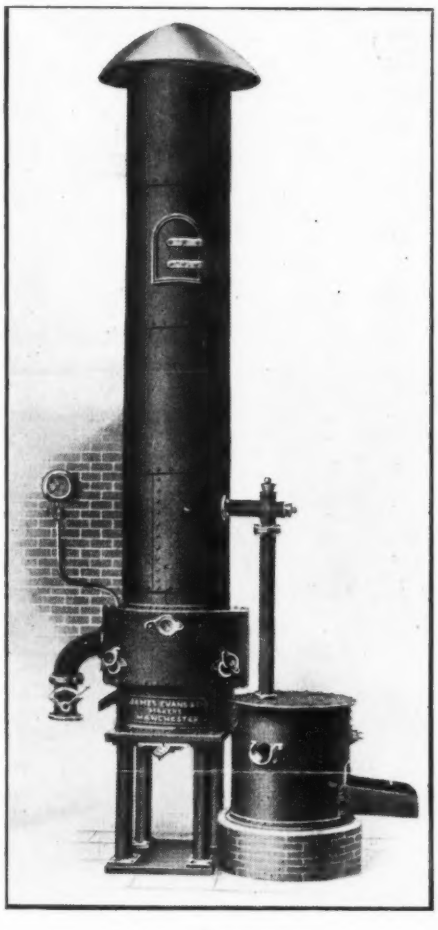

FIG. 3.

cupolas store a limited quantity of metal, and when a larger quantity is required than the cupola will carry at one time, then a suitable ladle is used as a receiver and the cupola is tapped at intervals to fill the ladle. During the time of subsequent tappings the metal in the ladle must be kept as hot as possible, and for this purpose it is customary to prepare a coke fire in the ladle which floats on the metal and assists considerably in retaining the heat. With the receiver type of cupola, as illustrated in Fig. 3, a reservoir of metal is obtained which will maintain its temperature for a longer time owing to its connection with the cupola. This type of furnace is more economical when used for work of a standard character when a regular mixture of metal is desired because the receiver is more or less a mixing chamber also. With ordinary cupolas the height of the tuyeres above the hearth is governed by the amount of metal it is desired to accumulate in the cupola and as the bed charge of fuel is determined by the height of the tuyeres when much metal is required to be carried the ratio of fuel to metal will be considerably influenced. On the other hand, when the furnace is used solely for melting purposes the tuyeres will be near to the hearth and the bed charge is materially reduced which makes it more economical in the use of fuel.

Tuyeres.

The tuyeres convey the air from the air-belt to the inside of the cupola. Some of the smaller furnaces do not carry an air-belt, but receive the air direct from pipes to the tuyeres. In some cases only tuyeres are employed. Generally, however, the number of tuyeres varies from 3 to 6 in one plane and there may be one, two, or three rows of these in the cupola. In many, the openings are circular in shape, but as a rule rectangular-shaped tuyeres give better results, at least inside the furnace, because of the better facilities they offer for distributing the air. The tuyeres are usually increased in area from the air-belt to the inside of the furnace for better distribution, and generally the combined area of all the tuyeres at their smallest ends should not exceed a quarter of the area of the furnace, though it may be less: depending upon the amount of blast and the length of time during which the blast is on.

The height of the tuyeres above the hearth is determined by the duration of the blow and the amount of metal it is desired to hold before tapping. The tuyeres require to be higher when the furnace is to be worked for five or six hours than when it is only worked for two or three hours in order to accommodate slag and, should the furnace be required to accumulate metal for large castings, in order to reduce the number of tappings the height of the lower rows of tuyeres will be at a height above the hearth to suit the amount to be carried. Using coke, the fuel usually employed in this country, the height of the lower row of tuyeres from the hearth varies from 12 to 20 in. in the ordinary cupola. In the more modern cupolas the area of the tuyeres can be varied.

No hard-and-fast rule can be given respecting the pressure at which the air should be supplied.

Air Pressure.

The pressure is variable, depending upon the area of the tuyeres, upon the amount of fuel that is to be consumed, the height and diameter of the cupola, the rate of melting, and, to an appreciable extent, upon the size of the metal forming the charge. The air introduced should be distributed as evenly as possible over the area of the cupola in order to obtain a regular consumption of fuel. To consume 1 lb. of coke 134 cub. ft. of air is necessary, or, if the ratio of melting is, say, 7 to 1, that is, 7 lbs. of metal to 1 lb. of coke, then the amount of air per lb. of metal will be 19 cub. ft. approximately, and this multiplied by 2,240 will give the amount of air to be supplied to the cupola per ton of metal to be melted. The latter method of calculating is the usual one adopted, although really it depends upon the amount of coke to be consumed. The ratio of metal to coke is, of course, a variable one, and depends upon many factors with which it is not necessary to deal at present. Then, cupolas that are comparatively short for their diameter between the tuyeres and the charging door generally require more air than those having greater height, because more is likely to escape without being consumed. The pressure of air, or rather, the volume of air, has considerable influence on the rate of melting, and it is convenient to the facilities for increasing or decreasing the pressure of the blast according to the amount of metal required in a given time. When the cupola is charged with small scrap the pressure can be profitably reduced from that necessary when large scrap and pig is charged, because less escapes without being consumed. The air pressure is sometimes referred to by its capacity to lift water, and a water gauge is frequently used to determine the pressure. Now a pressure of 1 oz. per sq. in. is represented on a water-pressure gauge by 1.73 in., or inversely, a lift of 1 in. of water in the gauge will represent a pressure of 0.578 ozs. per sq. in. Thus the pressure may be in inches as represented on a water gauge, or in ozs. per sq. in., and in practice the pressure varies between 15 and 25 in. or 8.67 and 14.45 ozs. In exceptional instances

the pressure may be less or greater, but it rarely exceeds 16 ozs. per sq. in.

Blowers or Fans.

Opinions differ considerably on the most suitable mechanical means of compressing the air and delivering it to the cupola. In many foundries a comparatively large fan is used, revolving at a high speed. On the other hand, many prefer a positive blower. The fan is influenced by the varying resistances of the air supplied in the cupola. Thus, as the resistance increases, so the volume of air from the fan is reduced. The blower is more constant and is not so easily influenced by the resistance to be overcome. It, however, requires more power to drive it, and is therefore relatively more costly. A combination of the fan and blower is now frequently used, in which vanes revolve as in the case of a fan, but which are wholly encased. The casing carries the inlet and outlet branches.

It should be possible to vary the speed of blowers in order to regulate the speed of melting, but this is not always done. The distance between the blower and cupola should be as short as is practically possible, and the air should be dry to obtain the best results. There should be no awkward bends in the pipes conveying the blast. Easy sweeps are desirable.

Charging the Cupola.

The cupola is started by way of the breast hole, and an auxiliary blast is frequently employed to hasten the partial consumption of the bed charge before the breast plate is secured. The coke should be carefully placed to form a fairly regular barrier, so that when the breast plate is fixed, sand can be rammed between it and the coke. Many furnacemen prefer to daub up the breast plate with loam and press it over the breast hole where it is wedged into position with the tie bar. Loam is then used to seal the outside between the covering of the cupola and the breast plate. It matters little which method is adopted as long as it is properly done to support the pressure and the material used is sufficiently refractory to withstand the high temperature of the metal. Both slag and tapping holes are usually kept open during the time of fixing the breast plate, but closed at the commencement of the blow. The amount of bed charge varies, but it should not be less than 12 in. above the tuyeres, and may be up to 20 in. if the blow is likely to be prolonged. The first charge of pig and scrap iron can be considerably greater than subsequent charges of pig and scrap, and the charges of metal should be interposed with charges of coke, the amount varying according to requirements and the peculiarities of the individual cupola, to maintain the height of the coke bed. A few pounds of limestone should form part of the charge, sufficient to make the slag fairly fluid, but the amount should be kept as low as possible because too much is injurious to the cupola lining. In order to give an approximate idea of the charging of the cupola it may be profitable to give an example of, say, a 2 ft. 6 in. furnace, this being the diameter at the tuyeres, having a height of 12 in. from the hearth to the bottom of the tuyeres. The bed charge of coke may be approximately 4 cwt., and the first charge of pig and scrap iron 15 cwt., and subsequent charges of coke and metal being in the ratio of 1½ cwt. to 10 cwt. If there are nine subsequent charges of 10 cwt. of metal, making a total charge of 5 tons 5 cwt., and 17½ cwt. of coke, the ratio of metal to fuel, including the bed charge, will be 6 to 1.

The time of starting the fire in a cupola to the charging of the first iron will vary considerably, because not only are many influenced by the direction of the wind, but some make use of natural draught through the breast hole, while others supplement this with air from the blower. Then a full charge to the charging door is made before the blast is put on, but under favourable conditions fluid metal will be seen trickling down within 15 minutes of the blast being put on. The metal is visible through mica observation holes on the air belt, which are placed to give access to the tuyeres.

This brief description of the charging of a cupola with the example is merely to serve as a guide. Considerable skill is required by a competent furnaceman, not only in charging, but in keeping the furnace in a melting condition by reducing its tendency to scaffold and in attending to the tap hole. As the fluid metal rises in the chamber below the tuyeres, the slag comes nearer to the influence of the cool blast, which causes it to become more or less chilled, with the result that some adheres to the furnace lining. Much slag is, of course, drawn off through the slag hole, but some will adhere, and if the length of blow is prolonged, more slag gradually adheres, and will, if not attended to, gradually close the furnace or "bung it up." This is what is known as scaffolding. The tuyeres can frequently be operated to reduce this tendency by preventing the cold blast blowing directly on the places affected, but it is often necessary to break away the chilled slag, and, for this purpose, access is made possible by way of the observation holes and tuyeres. When the time during which the blast is on is short, say two or three hours, the tendency of the cupola to develop scaffolding is not usually sufficient to influence the working capacity, but for long blows it must be guarded against in order that the cupola will render effective service.

The tap hole should be kept clear of slag and chilled metal, because clay, which is used for "botting-up," will not adhere so well to these, and it is more difficult to use the bot-stick. All cupolas seem to possess little peculiarities, to which the experienced furnaceman becomes accustomed in course of time, and only when he has become accustomed to them is it possible to get the best results from the furnace.

Coke.

In this country particularly coke is the fuel generally used, and in order that good results may be obtained from the cupola it is important that the quality be good. All cokes contain sulphur to a varying extent, and as the coke is directly in contact with the metal, which has an affinity for sulphur, it is important that the percentage of this undesirable element should be low. The sulphur in coke should not be greater than 1 per cent., and it is preferable to have less, although coke of very low sulphur content is frequently soft, whereas a hard coke is desirable. The amount of sulphur absorbed by the iron depends upon the time the iron is in contact with the coke in a fluid state, upon the composition of the iron, and upon the flux used. Thus the longer the fluid metal is in contact with the coke the greater the amount of sulphur is likely to be absorbed. On the other hand, the lime in the limestone-flux has a strong affinity for sulphur, forming a sulphide which is carried off in the slag. As a rule a high temperature in the cupola favours the removal of sulphur in this way, and this condition also favours the combination of manganese with sulphur to be carried off with the slag. Coke should be free from moisture, and leave a minimum amount of ash after being consumed. It is profitable to have a careful analysis of each consignment of coke in order to ensure that it is of standard quality, and to make slight modifications in the charging of the cupola if the analysis varies.

Effects of Heating Silicon Steels.—In the course of a Paper read before a recent meeting of the American Institute of Mining and Metallurgical Engineers, Mr. Norman B. Pilling stated that practical limitations to the usefulness of silicon steels are the hardness and brittleness which silicon imparts to iron, making iron-silicon alloys of more than 8 per cent. silicon content unusable except where castings can be employed. In the use of commercial silicon steel in thin rolled sheets, as in transformer construction when the silicon content exceeds 4.2 per cent. the sheet is too brittle for satisfactory shaping by punching or similar operations. When such a brittle steel is sheared it frequently breaks along a haphazard path in advance of the cutting tool. In getting to the root of the cause of this brittleness, information as to the actual path the fracture takes is of primary interest. The fracture in silicon steel follows cleavage planes of the crystal. Anything that serves to break the continuity of the path of rupture will aid in checking it. Hence, the frequent change in direction that the fracture is compelled to make in passing from one grain to another is an effective agent in limiting an incipient fracture.

Common Defects in Small Important Castings.

By S. G. Smith, M.I.Brit.F.

It is proposed in this article to outline a few of the numerous small parts for engines which have from time to time given much trouble and dissatisfaction when passing through the operations in the machine shop, and as a consequence usually find a place in the scrap heap.

Some patterns, when sent into the foundry, indicate very little regarding the machining operations, hence it is always wise on the part of those in charge of the work to ascertain the future history of such castings. The author is aware in some cases the foreman has but little time to make such inquiries, but that is not a justifiable excuse. When wasters are repeatedly made much unpleasantness follows when such are returned to the scrap heap. Hence every opportunity must be taken to ascertain what is required from it. It is often difficult to make certain castings satisfactorily for the engineer when its functions are known in the foundry, but it is infinitely more difficult to make such when its future history is unknown.

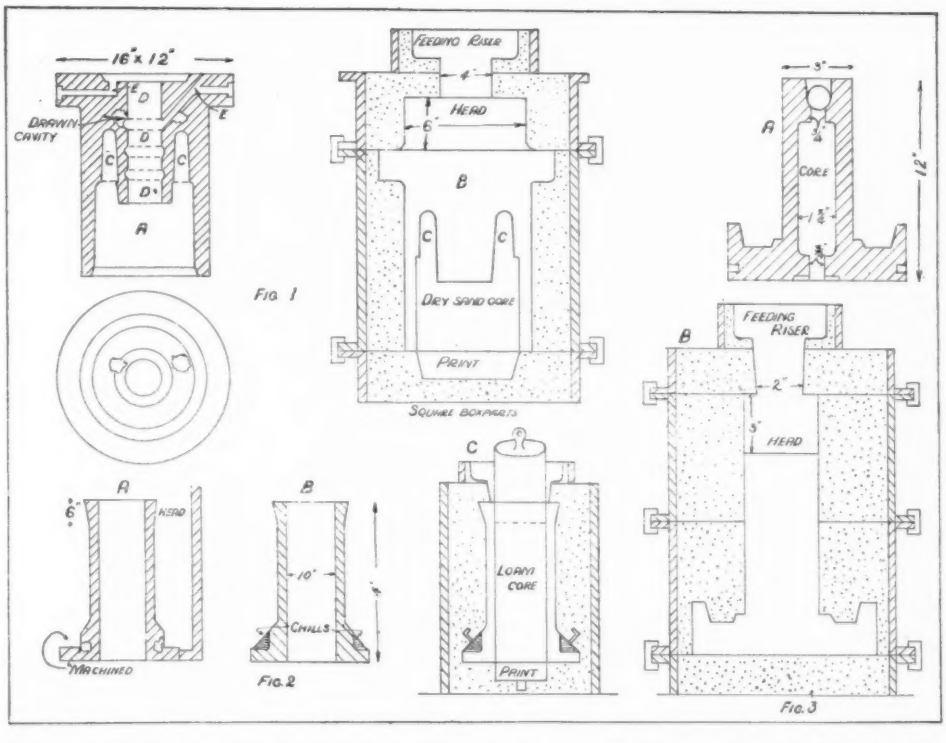

FIG. 1 FIG. 2 FIG. 3

Steam-Chest Cover.

Fig. 1 shows a cover for a turbine steam chest. This casting is practically machined all over, the only part that is not machined is indicated at C, in both sketches. The centre and the three recesses (D) are bored. The small diameter holes (E) are drilled. The casting must be of dense and perfectly sound metal, for if any appearance of sponginess or specks develop during the machining operations it is at once scrapped. From sketch A, Fig. 1, it will be realised that to meet these requirements needs some special care when moulding the casting. The author, being one of those unfortunate persons who is expected to succeed where others have failed, and the record of this particular casting having been very poor, special attention was demanded.

Formerly these castings had been made in many various ways. The centre bore, D, was formed by a core; when this was done, no matter which way it was poured and moulded, the porous, spongy places indicated by arrows always occurred, this defect, without further consideration, being sufficient to scrap it.

Eventually it was decided to omit the core and cast it solid, placing a large feeder on top. When this method was carefully carried out, sound and satisfactory castings were produced; but owing to various and changing circumstances, the care initially exercised lapsed, with the inevitable result. This made it necessary to take action on the following lines, which speaks for itself and needs no further comment.

In previous years, when instructions have been properly carried out, results have been good. Since then different foremen and moulders have made it according to their own ideas, with disastrous results. The author finally settled the matter in a way that made it impossible to alter the method of moulding, pouring, and feeding. He did this by making the feeding head part of the pattern. This feeding head is fed in the ordinary way by rod, and finally cut off in the machine shop. Since this plan has been put into effect the trouble has ceased to exist. The sketch of the mould (Fig. 1) will make this matter quite clear.

Cylinder Head Bush.

Fig. 2 relates to a cylinder-head bush. The surface at the ends, the bore, and parts indicated by arrows are machined and must be perfect when finished. The defects of this casting, which are porous places indicated by arrows, are shown at A (Fig. 2).

This casting is 4 ft. long, and with 6 in. of head, and adding the distance from the top of the head to the top of the runner gate and riser another 8 in., it makes a total length of 5 ft. 2 in. Now as this casting is poured in the vertical position as shown in the sketch C (Fig. 2), it is rather remarkable with the static pressure exerted that either porosity or segregations should exist where they are indicated.

Leaving aside the cause, the cure was the more important matter. These castings had been poured through an ingate into the bottom flange, which appeared to be a good and clean way of running them, but it was the chief cause which contributed to the porosity in the locality shown, due no doubt to the

hottest iron remaining in the thickest section of the casting. The combination of these two factors occurring would cause a draining away of the liquor from the last place to solidify, leaving those parts porous and hollow. If the castings were poured from the top of the head direct down through small runners, which is often done, the possibility of porosity occurring would be very remote, due to the hottest iron being poured from the top, the effect being opposite to pouring at the bottom. But pouring from the top alone causes a considerable splash on the bottom of the mould and the formation of small pellets and cavities would be equally as detrimental as porosity, especially in this particular place which is most vital owing to the joint of the cylinder head being made at this part.

The plan the writer adopted was to make sure that soundness would result whether poured from the top or from the bottom, and this was attained in the following manner.

A circle of chills, or denseness, divided into six sections was carried around the flange as shown in sketches B and C (Fig. 2). This was a very simple matter. One chill pattern, the sixth of the circle, is all that is required. They are moulded in the ordinary way with a lifter cast in it, so that the sand will grip and hold the chill in its proper position when the pattern is drawn and the mould is being handled. The liners are moulded on the flat and " up-ended " for pouring. The chills need no preparation except a little dry plumbago rubbing on, and they can be used repeatedly for a large number of castings. When not in use they should be kept in a dry place, and no rust or oxide should be allowed to gather on them. When molten metal comes into contact with rust, it is similar to putting a lighted match to gunpowder, a gas is evolved after the explosion, which is often trapped in the metal.

Sketch B (Fig. 2) shows the chills on the flange, while sketch C shows the mould as it is poured with the chills in position. Since these chills have been applied the writer has not known one instance where porosity has occurred. By some misunderstanding one of these castings went through the foundry without the chills being used, but the inevitable porosity was present, which very much perplexed the writer until it was admitted that the chills had not been applied. Such patterns are now made as near as can be fool-proof.

Size of Chills.

Some care must be taken as to the size and area of the chill, which must be sufficiently large to hasten solidification, but not sufficient to bestow a hardness that will not machine. In the present case there is no fear of hardness as the section is so thick, and hence the cooling is still quite slow.

Valve Pistons.

Fig. 3 relates to a valve piston for a turbine steam chest. It is machined all over, and also bored. Its function in the steam chest valve demands that it must be without speck or blemish either in the bore or any part of the outside. These castings are made in several sizes, and the record for wasters in the past would be difficult to surpass. The castings made under the supervision of various foremen and different moulders all seem to have met the same fate, and it appeared to be only by accident when a good casting was produced. It has been moulded and poured both small and large end upwards. The runner gates have been tried from the top, half-way down, and the bottom of the large end of the casting. The number of defects have been many, but the chief are these: (1) When poured with the large end upwards dirt, draws, and porosity appeared on the top surface; (2) if the machining allowance was increased (which was sometimes done with the trowel by the moulder) naturally it only increased the already existing tendency for draws and porosity; (3) when the casting was poured the small end upwards, the result was blowing, scabbing, pellets and cavities.

When attention was last given to this matter the author found the chief cause of most of the troubles was caused by the centre core shown in sketch A (Fig. 3), which is a kind of double bottle neck or chamber core. In this piston the diameter of the chamber is 1¾ in., and the small ends are ¾ in. dia. This core needs considerable care in the making to allow the generated and expanded air and gas to escape freely from such a long chamber through a very small diameter vent at either end.

When the casting was poured the large end upwards, the core prevented adequate feeding with the rod. It was discovered in order to give better facilities for feeding, the small diameter end of the core was cut off to the chamber; this of course necessitated the core being held central by means of sprigs, additionally the air had to make its escape from the bottom vent only. A whole train of defects followed this method.

There are times when a foundryman, especially the expert, must take a bold course, and in this case, after consulting the designer and the foreman engineer who had charge of the machining operations of the castings in question, the writer asked them plainly: Is it possible to machine, bore, drill, or slot certain parts of the casting that are at present cored out? The reply being in the affirmative, the writer proceeded, with their knowledge, if not their consent (because there are generally protestations of extra machining cost etc.), to eliminate the cause.

If it be the core that is causing the defective work, the matter for, and against, are carefully considered, and if the end justifies the means the obstacle is removed.

In this case the core was omitted and the piston cast solid. To the small end was added 3 in. of head, with a large feeder on top. It was poured with a fountain runner-gate from underneath the bottom. Sketch B (Fig. 3) illustrates the mould. This method has proved entirely satisfactory.

(To be continued.)

Linton Lock Hydro-Electric Power Station.

The new Linton Lock hydro-electric power station at York was formally opened on Wednesday by Princess Mary Viscountess Lascelles and Viscount Lascelles.

Owing to the high price of coal at the end of the war, and in the following years, the York Corporation studied the advisability of erecting a hydro-electric power station in the neighbourhood of the city as the best means of meeting the increasing demand for electricity. It was found that one of the most favourable sites was on the River Ouse, at Linton Lock, which is about 11½ miles from York. The Ouse has a very variable discharge; roughly speaking, this varies from 50,000 cub. ft. per min. in dry periods, to 200,000 cub. ft. in the wet months. Taking 100,000 cub. ft. per min. as an average, with 8.83 ft. head, 1,200 h.p. could be expected from the proposed station. A close calculation showed that the available energy in years of normal rainfall would exceed 2,750,000 kw.-hrs. per annum.

The power station is situated on an island, and the supply and erection of plant in one comprehensive contract was awarded to The English Electric Company, Limited, Queen's House, Kingsway, London, W.C.2. The power house is carried on 110 ferro-concrete piles, which go down to 60 or 70 ft. below the normal ground level, and is now built of reinforced concrete instead of brickwork, as originally intended.

The water, entering the headrace or forebay on its way to the power house, passes through strainer racks and the main sluice gates to three turbines, two of 430 h.p. each, running at 60 r.p.m. and driving a 540-kw. generator, and one of 330 h.p. running at 75 r.p.m. and driving a 210-kw. generator. The generators are alternating-current 3-phase, 50-cycle machines, working at a terminal pressure of 6,600-7,000 volts. Both generators can withstand the runaway speed of the turbines, which is about 1.9 times their normal speed. The full load efficiency of the generators is about 94 per cent., and taking 80 per cent. as the average efficiency for the turbines and allowing 2 per cent. loss in the bevel gears, the overall efficiency of the power station is about 74 per cent. The power transmission to York is by means of underground cables, from which a supply will also be given to villages, etc., along the route.

Graphite and Graphitic Carbon.*

By T. Turner, M.Sc. (Professor of Metallurgy, University of Birmingham.)

Graphite is a material which is of importance from many points of view. There was its domestic application; it was used by the electrical engineer and in connection with the lubrication of machinery; it was employed as a conductor of electricity, and it was also utilised as a refractory in the production of crucibles and other articles which had to stand a high temperature and which were required to be chemically neutral in character. A few observations on the properties and occurrence of graphite might be of some interest to foundrymen, because the foundryman was accustomed to the use of graphite for mould dressings, and he was particularly interested in it in the grey cast iron which was used so extensively in foundry work.

Carbon was met with in allotropic forms. It was a material which was essentially carbon, and nothing but carbon, and yet on the one side possessed the hardness, the transparency and the high value of the diamond. On the other side, it was carbon in the form of a soft black powder, which ignited at a relatively low temperature, which had great powers in certain forms of absorbing gases, of decolorising organic liquids, and acting as an antiseptic, and generally behaving in a manner as different from that of a diamond as it was possible to conceive. Between these two extremes there was graphite itself—the material it is proposed particularly to consider. The diamond which occurred in the cubic crystalline system, and the more complex derivatives of the simple cube, belonged to an entirely different system from that of graphite. This was the hexagon, and was a structure which had been studied in recent years with the aid of X-rays, with the result that one now knew something more definite about the structure of graphite than previously.

Properties of Graphite.

The first and most obvious property of graphite is that it gives a polish or a lustre to any article with which it is rubbed. There is a simple test which anyone could apply to ascertain whether he is dealing with graphite or not, which is to rub it on the palm of the hand, and if it gives a polish, one could be sure one was using graphite. Graphite is relatively dense, almost of the density of ordinary common rocks, approaching 2.5 per cent. It has a high ignition point, 670 deg. C.—that is, just about a good visible red heat, or say the melting point of aluminium. The other forms of carbon in an amorphous state would ignite distinctly below that point.

Electrical Use of Carbon.

The electrical use of carbon depends on the curious fact that, although it is a non-metallic element, it is an excellent conductor both for heat and electricity. One could distinguish between graphite and amorphous carbon by the properties outlined, namely, density, ignition point, the lustre or polish test. Additionally, there is the fact that graphite, if repeatedly deposited in some strong nitric acid, forms a white soluble compound, called graphitic acid. This was shown many years ago by Sir Benjamin Brodie, the eminent chemist. It was possible, therefore, chemically to distinguish the one from the other.

Production of Diamonds.

One might be tempted to ask how a diamond was produced, and what it was that caused amorphous carbon to take a graphitic form. If so, then a reference should be made to the researches of Sir Charles Parsons and others, who had shown a great deal as to how diamonds could be produced, but none had demonstrated how they could be made commercially. It costs much more to make a diamond at present than what they could sell it for. High pressure and moderate temperature were required to produce these gems. They conceived that this was so in nature, because in Kimberley, and other places, where diamonds occurred, they were associated with a characteristic blue clay or rock. That blue clay, if heated to the temperature of about the melting point of blast-furnace slag, would in all probability melt. It is perfectly clear it would melt easily in an electric furnace, and since diamonds existed in the clay, and the clay had not been melted, they might assume that, whatever the pressure was at which the diamond were made, the temperature was not higher than would melt the matrix in which they were found. Amongst the hard rocks, the Mount Sorrel granite used for repairing the roads in the Midlands could be rendered fluid in a crucible in which cast iron was melted, and could be done quite as easily. From such a melting there is obtained a more or less glassy material, and if diamonds were found in material of that character, they might assume that only a moderate temperature was required in order to make them.

Artificial Graphite.

Graphite can be artificially made, and is to some extent by heating carbon, but again it is not necessary to have a very high temperature to make this graphite. Details have recently been published of experiments in which it is alleged that carbon has been actually melted and obtained in small globules with a high temperature under electric heating, and that these globules are graphite. Thus the material, even at this high temperature, is still graphite, and not diamond. But it is not necessary, perhaps, to have so high a temperature as this, as could be proved by examining rocks, for graphite occurs in the schistose and metamorphic rocks such as those representative of the large deposits in India. These rocks have been worked on a considerable scale, but only contain about 11 per cent. graphite; the rest is mere crystalline rock, which can be easily melted in a furnace. Hence it was again assumed that graphite is formed under pressure, not necessarily high pressure, and, comparatively speaking, with a moderate temperature. Moreover, when carbon was in solution at what, from a metallurgical point of view, was a moderate temperature of, say, roughly 1,000 deg. C., the deposits from this solution might take the form of graphite; and it was known that graphite can be so deposited at as low a temperature as 700 deg. C.

Occurrence of Graphite.

Graphite is met with in many parts of the world, and originally perhaps at Borrowdale in Cumberland, where from the metamorphic rocks lead pencils were cut. These mines were only worked during certain months of the year, so that the market should not be overstocked. One of the first improvements was introduced by Sir Henry Bessemer, who suggested the crushing up of the inferior graphite and separating the gritty matter by applying a current of air, the fine dust being pressed into blocks, from which lead pencils were then made. Large deposits of graphite were to be found within the British Empire. Considerable quantities, it is true, were obtained from the United States during the war. The United States then produced a larger quantity than the output of India and Ceylon put together, but the quality was not equal to that found in India and Ceylon, as was discovered when using it for making into crucibles. It is unfortunate that the graphite producers, who acted in an extremely patriotic manner during the war and largely developed their industry, should have suffered so severely owing to the drop in the demand which followed immediately after the war. In this connection it is interesting to note that a report is now in print, and will shortly be circulated by the Imperial Mineral Resources Bureau dealing with the production of graphite and supplies the world over. Graphite often occurs in comparatively large pieces, but it is seldom that it is of commercial

* A Paper presented before the Coventry Branch of the Institute of British Foundrymen, Mr. G. E. Roberts presiding.

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use without the employment of some purifying process. There are impurities in the form of grit and ragged particles, irregularities and so forth, which have to be removed. One method used for this purpose is the froth flotation process of cleaning, the graphite being crushed, mixed with oil and washed, and the oil then separated.

The Grading of Graphite.

Graphite crucibles are not by any means pure graphite. They are made from a suitable preparation of plastic refractory clay, often as much as two-thirds of clay being used. One very important property of graphite that is necessary in order to make good crucibles is plasticity, which appears to be associated with a particular form of graphite, as William Bragg has shown by X-rays. It is a small form of curved graphite, which has this plasticity. Otherwise the crucibles are apt to be tender, and would prove disappointing in that they are liable either to crack with heating or to break when handled. Therefore it is not sufficient to have a graphite which is very refractory, but also to ensure that it has this plastic property.

Graphite in Cast Iron.

In white cast iron there is no graphite, but in grey iron, however, graphite occurs in at least two characteristic forms. But how does one know that there is graphite in grey cast iron? What simple proofs are there? Some of the graphite, sufficient to identify it, could be separated merely by washing it with water and collecting the lighter portions, which have the appearance of mud, and practically is mud, or a fine froth. A close examination of this revealed two things:—(1) Small flakes which formed the primary graphite; and (2) the very fine particles which resemble mud and is secondary graphite. The proportion of free graphite in cast iron filings and its size can be readily gauged by the ease with which a polish is obtained when rubbed on the hand. Assuming cast-iron filings to be all of the same size, the amount of graphite would approximately vary directly to the polish obtained. To separate graphite chemically acids, such as hydrochloric acid, have to be employed in order to dissolve as much of the iron as possible. The precipitate is treated with nitric acid further to extract the iron, and then, having washed out the iron, it is treated with caustic soda or potash so as to eliminate the silica. The acid and potash are again employed for separating and washing, and to get a still purer graphite it is desirable to use hydrochloric acid. Stirred and washed and dried, a carbon should then be obtained which is almost perfectly pure.

Varieties of Graphite.

It is noticed on examining this graphite that its character differs according to the kind of iron from which it has been obtained. The coarser and more open the grain of the iron, the larger the graphite flakes. A No. 1 iron would yield a coarse graphite, and a No. 4 iron would produce a fine graphite with a little coarse.

Graphite from a certain No. 1 iron would not pass through a 60-mesh sieve, whilst in other irons the graphite would pass through a 90-sieve, or at least the greater part of it, very little remaining on the 60 or 80-sieve. This type produced an extremely fine powder. These respective forms of graphite seen side by side disclosed a marked difference, which can be associated with the grade of pig-iron from which they were produced. Now what would be the effect of this difference in graphite? Assuming there is in a sample of iron some fairly large flakes of graphite, and the stress is put upon the iron as in a tensile test, then where these large flakes occur there is practically a hole and no cohesion. Obviously all the stress would fall on them, and the iron would relatively easily come asunder. But supposing an iron containing small graphite is tested in tensile, if a crack occurs it will not go so far across as in the first case; the crack will be stopped, and the effect would resemble the case of a piece of paper folded many times. Iron is less liable to break or crack through if it contains a number of very small particles of graphite than if it has no graphite at all. Better results can be obtained with a first-rate sample of malleable cast iron than with similar iron if it contained no free carbon. This, of course, relates to extreme cases, where there are large flakes of graphite and very small particles.

Production of Primary and Secondary Graphite.

An investigation into the constitution and properties of graphitic carbon obtained from cast iron, using a small cylinder of the material placed on a plate and examined under X-rays, reveals that the crystalline character of the graphite is shown by the dispersion which was caused in the X-rays. Natural graphite shows the same effect. Being so very fine in character, temper carbon has a kind of bloom round it. In sugar carbon, however, which was an amorphous carbon, there was no halo. An experiment has been conducted by a Japanese student doing research work at Birmingham University which demonstrates that what they called temper or carbon or secondary graphite is really a true graphite. This work was being carried forward by another student in the author's department in other ways. He has shown, and the results would be published shortly in a Paper referring to density, lighting point, action of acids and certain other properties, that all the carbon that separated from cast iron, all the elementary carbon, is graphite and nothing but graphite. There are in this respect no two kinds of carbon, only one. But according to the conditions under which it separates, it may be flakey (primary), associated with the highest temperature; or it may be small in grain (secondary), associated with a lower temperature. Secondary graphite is usually associated or accompanied by strength, but not always. Primary graphite gives softness and weakness.

Expansion Tests.

In the case of white iron there is no important expansion, but with grey iron, solidifying at a temperature of 1,150 deg. C., the metal expands and then contracts; it expands again, and continues to contract. At the first expansion the coarse-grained graphite begins to be separated, and continues to do so to the same extent as the sample cools down. Passing into the next stage, a fair amount of fine-grained graphite is separated—the maximum somewhere below 900 deg. C. It begins to separate at about 900 deg., and having once started one could lower the temperature considerably; but the process still continues producing graphite until at 700 deg. C. there is the last separation of this fine graphite. Though really a continuous process, there are two stages in which the separation is being carried out at a very fast rate. If any of these alloys are allowed sufficient time—supposing there are other elements in them—after reaching or passing the ejection point they would deposit carbon, but in some cases it would take perhaps months. The more slowly the metal cooled and the coarser the grain the more graphite they were likely to obtain. A microphotograph of a cast iron showing a normal graphitic structure, associated with a good, tough, pure iron, may not necessarily be a very good iron. Of such a character is Swedish grey iron, wherein the graphite is curled, and is too large to be amongst the strongest irons. However, it is good, tough iron for a great many purposes. To make it stronger it must have the graphite smaller. It has a tensile strength of about 15.8 tons per sq. in. About fifteen years ago it was regarded as the strongest iron to be found in the country, but now it is quite common regularly to obtain 15 tons tensile. Mr. F. J. Cook and others, with special experience of different irons, would feel reasonably sure of obtaining 17 tons every time, though they could not get this unless they have graphite very much like that described.

Phosphoric Iron.

With this type of iron there are associated long, straight pieces of graphite, more or less spearlike in character, as it is cut through. Practically no very fine graphite is to be found in it. Should a soft iron be desired, then there must be a fair amount of primary graphite, though it should not be in pieces which are too large. Some 2½ per cent. is required to give a grey iron, but the graphite must be in a fine state of division.

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Malleable Iron.

Malleable iron is a very important material nowadays, and if a good casting is essential, the white iron must contain, both before and after melting, no graphite, otherwise there would be trouble. For the white-heart process, by raising the temperature and heating the metal, solely secondary graphite, and no primary, would be obtained, although primary would be obtained if the temperature was raised too high, the flakes being then quite easily distinguishable. The temperature must be taken up slowly and kept at the proper figure—900 deg. C. for the ordinary process, as also with black heart—while the carbide gradually decomposed and precipitated secondary graphite.

In this connection it should be noted that if the temperature becomes too high, the effect is to popularise the carbon. It should be remembered that carbon is solluble in iron, and if the temperature is taken higher than is required, the precipitated carbon begins to dissolve again. The result was that the metal became hard, irregular and unsatisfactory. In black-heart malleable, the secondary carbon can dissolve again, giving a hard interior. In the outside portion of European malleable the carbide is not only thrown out, but exuded and removed.

DISCUSSION.

Nature of Kish.

MR. HARRIS, opening the discussion, said that Professor Turner had mentioned primary graphite in cast iron, but had not spoken of kish, which was a matter in which foundrymen were all interested. Could kish be looked upon as primary graphite, and was it definitely pure graphitic carbon, or was it a compound of iron and carbon? He had taken various samples of kish from hematite pig-iron, and he invariably found that it was magnetic and also contained iron. He had wondered whether this was due to impure samples of kish where the iron was not chemically combined, or whether it was a definite compound of iron and carbon.

PROFESSOR TURNER said that they might say kish was the separation of the primary graphite whilst the metal was hot, and that what one found in the ordinary casting was kish which had been separated and developed while the material was semi-solid and plastic. It was quite correct that there were impurities. Some samples were much more dense than others, and almost all metals were magnetic that contained an appreciable amount of iron. But if this material was treated as if they were purifying ordinary graphite, they could obtain kish which was practically free from sandy or slaggy matter. These chemical impurities must be removed by chemical means. Kish was simply the same thing as primary graphite, only of a larger size.

Effect of Silicon on Carbon Saturation.

MR. HARRIS remarked that with iron containing about 1.8 per cent. silicon, low phosphorous and perhaps 1 per cent. manganese, it was found that the total carbon very rarely exceeded 4 per cent. He wondered whether that was the definite saturation point of iron and carbon of that silicon content, and referred to the effect of a similar mixture with carbon up to 4.3 per cent.

PROFESSOR TURNER replied that, as the silicon increased, the capacity of the iron to dissolve the carbon fell, and 4.3 per cent. was the saturation point for pure iron. When they came to 10 per cent. silicon the saturation point was under 2 per cent. of carbon. Taking hematite iron, 2 per cent. of silicon would be saturated with something a little under 4 per cent. of carbon.

Nodular Graphite in Grey Iron.

MR. F. H. N. LANE, remarking that so far he believed no mention had been made of graphite occurring in nodular form in grey cast iron, said he had seen micro-photographs taken from sections of cast-iron pistons in which it appeared to be in nodular form. Could the lecturer say under what conditions this would be? In this particular case, the piston had shown evidence of porosity round the boss which was rather difficult to overcome. It was a fairly close-grained iron, and he did not know whether there was any connection between the porosity and that form of graphite.

PROFESSOR TURNER did not think it was due to graphite that porosity occurred. Probably the nodules were of sulphite of iron. These did separate, and were black and looked like graphite. They could be crushed up, too. He should certainly say they were impurities—manganese sulphite and iron sulphide. He had a case the previous week. Two pieces of iron were submitted to him from the same casting apparently. One was quite sound and good, but rather high in sulphur. A portion was quite porous and blown, and he could pick out little flaky nodules which they might suggest were graphite, but they were not. They were manganese sulphide and contained 0.7 per cent. sulphur, or ten times the ordinary amount of sulphur. What would happen if they could get through that particular part, added the lecturer, was that they would find the sulphur was very much higher there locally.

Carbon in Semi-Steel.

MR. G. H. JUDD inquired whether the lecturer had any experience of the addition of steel to cast iron, and mentioned that various authorities seemed to be at variance as to whether this addition of steel in the cupola caused carbon to be picked up or not. Both sides gave or produced results to prove their contentions. Had the lecturer had occasion to examine samples which proved that the steel addition did take up carbon?

PROFESSOR TURNER remarked that semi-steel was a very old mixture. It was known before he was born as Stirling's cast iron. The mixture was now almost invariably made in the cupola, and as to how much carbon would be taken up would depend on the method of working the cupola. The amount of blast, for instance, which might result in excessive oxidation, or *vice versa*. With a given temperature in the cupola in the presence of carbon there was a certain definite maximum amount of carbon which tended to be taken up. In ordinary cupola practice this was something over 3 per cent. if they put in a large proportion of scrap. There was a normal content of carbon for a certain cupola temperature and rate of working, and they would not get beyond it. If he were putting in a mixture containing 2 per cent. of carbon he should expect it to come out at 2.7, and if he put in another mixture with 2.7 carbon he should expect it to come out a little higher, but very surprised if it were to be over 3 per cent. If the mixture was lower in carbon it would take up more in proportion, because it was so much removed from the saturation point. In ordinary practice, if the amount of scrap was large they ought to expect something to be taken up calculated on the total mixture. Cupolas were rather irregular, but it was mainly a question of blast and time of exposure to a given temperature.

Contraction Allowances.

In a discussion on contraction, Mr. C. Dickin touched on the point of the impossibility of making good malleable, tough iron with graphite. (PROF. TURNER: I meant in the actual casting before you begin to anneal it.) He also asked in regard to choosing an iron with 0.8 per cent. silicon, would the lecturer consider that the contraction would be the same as in grey cast iron with about 2 per cent. of silicon.

PROFESSOR TURNER replied that any original contraction would be more in the white than in the grey iron, but when they came to malleable it expanded a little. But there would not be very much difference in the finally annealed casting in regard to shrinkage as compared with what there would be in a direct grey casting, as it would shrink quite as much approximately. As to the allowance for contraction by pattern-makers, it depended in part on the form of the casting. For example, a long, thin casting would shrink more than a short one. Shrinkage depended not only on the kind of metal, but the shape of the casting.

Proposing a vote of thanks to Professor Turner for his edifying lecture, MR. DICKIN said they had enjoyed a most instructive evening, and MR. J. M. MEESTON (Secretary), in seconding, said the lecture was given so lucidly that all of them could follow it quite easily.

China's Iron and Steel Industry.

By L. W. Hoyt.

Continued from Page 102.

The Tayeh Blast Furnaces.

The two new furnaces recently erected on the Yangtze River, about 65 miles east of Hankow, are called the Tayeh (pronounced Ta Yay) furnaces. With the exception of the blast furnace (Langyen) near Peking, these two stacks are the newest in China. Their *rated* capacity is 450 tons of pig each per day, or a combined yearly output of about 325,000 tons. The furnaces stand on well-made concrete foundations, the hearth jackets being about 18 ft. above the railway track level. The area immediately about the two stacks is surrounded by concrete retaining walls and filled to hearth level with sand. The surface about the hearth is paved with brick. There is no cast house in the strict sense of the word, as it was considered better to handle all iron in hot-metal ladles and carry it a few hundred yards to a special pig-casting house, where it is poured and allowed to cool. There is no pig-machine, however, this building being merely a detached cast house containing the sand pig beds to receive the hot metal. When the blast furnaces are working properly, this arrangement has some advantages, because it keeps the area about the furnaces clean and there is less heat to contend with during the hot weather. The disadvantages of divorcing the cast house from the furnace are apparent, however, during a "break-out," when perhaps a ladle is not at hand or cannot be placed to receive the metal. Then, too, this method increases the percentage of scrap metal because of more ladle "skulls" and runner scrap.

The charging system employed is that known as the "bucket" system. Many authorities consider that the bucket distributes the charge more evenly, but whether this be true or not, it would have been better to rely (in China at least) on the old reliable skip-hoist arrangement. There are many experimental features (from a Chinese standpoint) about the Tayeh plant, and due to inexperienced or inefficient construction at the site, many of these features have been responsible in part for the present disastrous state of affairs prevailing at Tayeh.

The furnaces themselves were designed by Dr. M. Oshima (deceased), technical adviser of the Han-Yeh-Ping Company up to the time of his death a year ago. Dr. Oshima had been adviser on metallurgical subjects in Japan, and was long connected with the Imperial Japanese Steelworks. After a thorough investigation of various types of furnaces in all parts of the world, he designed the present Tayeh stacks, and ordered them in Pittsburgh.

When "A" furnace was ready, the concrete water tanks collapsed, and orders were given to "blow in" anyway, pumping the water direct to the furnace. This, of course, was poor judgment, as an erratic supply of water was the result. But it cannot be claimed that this was the main reason for the enforced shut-down.

Later, it became evident that the bell was not closing tightly, and that, due to the excessive heat resulting, the operating arrangements at the furnace top were not working properly. Several attempts were made to adjust the machinery, but the heat unnerved the Chinese, and nothing seemingly could be done to remedy matters. This condition became more aggravated, until finally the loss of gas affected the temperature of the stoves, and this drop in temperature, coupled with a loss in pressure, soon began to be felt below the mantle. First one tuyere was lost, and then another, until only two were left. Finally, the entire furnace was lost, the charge freezing up. When sufficiently cold, the iron was blasted out and the furnace re-lined.

The above is a sad commentary on blast-furnace operation on what appeared to be the most modern blast furnaces in the world. Evidently someone had blundered. Some people in China are of the opinion that a 450-ton furnace will never work well there, because the coke is too friable and the burden pressure too great. The successfully-operated furnaces at Hankow are hand-filled and of 250 tons capacity. Undoubtedly a smaller furnace is less intricate and its operation more familiar to the Chinese now running blast furnaces in China. The Tayeh furnaces and plant cost close upon £1,000,000 sterling.

In concluding his review of these furnaces, the author points out that the coke used at Tayeh is very high in ash and friable, and that the iron ore is quite refractory, resembling magnetite in this respect. The furnace, the operation of which was so short lived, is larger than any others in China or India, and would ordinarily carry a heavy burden. The fact that the heat of combustion, however, was not in the proper zone—it being above the hearth to a considerable extent—prevented the carrying of a heavy burden. In addition to this, the refractory nature of the ore makes for a higher top temperature. With the zone of fusion away from the hearth and the burden lighter than expected, it was only natural that the top should become too hot for efficient working, and that the temperature of the hearth should be materially reduced. This reduction of the hearth temperature, coupled with the loss of gas at the top and loss of blast pressure, inevitably led to the shut-down.

The Tayeh Iron Mines of the Han-Yeh-Ping Company.

The Tayeh mines are located about 65 miles down the Yangtze River from Hankow, near a town called Hangshihkang. They lie about 15 miles inland from the south bank of the river, and are reached by a standard-gauge railway owned by the Company. There are four locomotives and 56 "battleship" ore cars in service. During the last 15 years the output has steadily increased, and in 1920 some 824,000 tons were mined and shipped. The 1921 figures show approximately 800,000 tons mined. The main ore vein is about 200 ft. thick, and conservative estimates place the ore tonnage in sight at about 35,000,000 tons. It is a rich hematite, and the run-of-mine ore will show 58 per cent. iron. Tayeh ore, in fact, is the best iron ore in China, and acts very well in the Hanyang furnaces at Hankow (but so far, not at the new Tayeh furnaces). On account of its proximity to the Yangtze River, this mine is also one of the chief sources of Japanese ore supply. Japan annually takes between 250,000 and 500,000 tons of Tayeh ore, in addition to a large quantity of Hanyang pig. Under a loan agreement (1913, backed by Treaty, 1918), the Japanese are entitled to ore and pig at a price fixed each year. The 1913 loan from Japanese interests (others have been made subsequently) provides that within forty years the principal and interest are to be paid in ore, pig, and to some extent in steel. Under the loan agreement it is definitely stipulated that during the period of the loan the Han-Yeh-Ping Company must sell a total of 15,000,000 tons of high-grade ore from the Tayeh mines to Japanese blast furnaces, exclusive of tonnage already contracted for. In this connection it is further stipulated that two tons of ore are to be sold to Japanese interests for every ton consumed by the Han-Yeh-Ping furnaces. It was also agreed that, commencing in 1919, the total tonnage of ore despatched to Japan should be annually augmented by 50,000 tons, until the total going to Japan would be 500,000 tons yearly. When conditions in the iron and steel market were better, Japan took all but 45,000 tons of the pig output of the Han-Yeh-Ping Company. At present this Company is making about 150,000 tons per year; so that Japan has been taking about 100,000 tons. It is reported, however, that, owing to the depression in steel, Japan is not pressing for all the tonnage in ore and pig that she is entitled to. A price of $21 gold (£4 7s. 6d.) was originally stipulated (1913), as the amount to be credited on the loan for each ton of pig-iron shipped. Owing, however, to the enormous rise in costs in all departments of the Han-Yeh-Ping Company, a compromise was arranged, and the amount credited is based annually on the price of Cleveland (England) pig. Even allowing for this more favourable arrangement, the price at which iron is delivered (and ore too) is below the cost of production.

(To be continued.)

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The position in the Tees-side pig-iron industry, as far as actual business is concerned, remains about the same as last reported, and there seems little prospect that any improvement in existing conditions is probable until the holiday month has run its course. Home consumers in the meantime continue the policy of hand-to-mouth buying, while export business is very quiet. Belgium is taking very little, though Germany is still buying odd lots, but there is very little business coming from Scandinavia and, generally, there seems to be a lack of purchasing power everywhere. In the meantime, Cleveland iron values are maintained at previous levels, and it would appear doubtful whether further reductions just now, even if they were practicable, would really be very helpful in the direction of bringing about any substantial revival of business. At present figures, pig-iron is being produced at a loss, and with fuel prices even firmer, the outlook is more difficult than ever. As to prices, No. 3 G.M.B. stands at 104s., No. 4 foundry at 100s., and No. 4 forge 97s. 6d., with No. 1 at about 115s.

Shipments of pig-iron from the Port of Middlesbrough during July (including Skinningrove 6,229 tons) amounted to 36,370 tons, as compared with 26,019 tons in June, an increase of 10,351 tons. The shipments from Skinningrove were up from 1,507 tons to 6,229 tons, but the feature of the returns is the increase to Germany, which took 15,875 tons, against 4,240 tons in June, or 11,635 tons more. On the other hand, the exports to the U.S.A. were down from 5,545 tons to 2,200 tons, and France from 1,275 tons to 215 tons, and nothing went to Canada, against 1,100 tons in June.

There is no indication of any improvement in the hematite trade. The present reduced demand fails to absorb the current output, and with stocks steadily accumulating, the prospect of having to damp down some of the furnaces becomes imminent. Makers, however, are very anxious if possible to avoid this alternative and, although business even now is quite unremunerative, they are not unwilling to make further concessions. Thus, although 100s. is still quoted for East Coast mixed numbers, the price has been shaded by about one shilling per ton for suitable orders. In West Cumberland and North Lancashire prices are also on the easy side, and the quotation of Bessemer mixed numbers at £5 12s. 6d. to £5 15s. per ton delivered at Glasgow and Sheffield can be shaded. Low phosphorus iron is in even weaker demand.

MANCHESTER.—Movements in the local pig-iron market are further restricted by holiday influences, and with most of the Lancashire foundries closed down for the current week, buying on contract account is at a standstill. So far as Midland pig-iron prices are concerned, some Derbyshire makers would not refuse orders at 97s. 6d., and there are cases where 95s. on trucks might be accepted for Midland No. 3.

THE MIDLANDS.—In the South Staffordshire area the problem at the moment with some smelters is how to carry on at all, and it is reported that furnaces are being damped down in the district. Demand has fallen off so considerably and prices have dropped to such an extent that there is no profit in pig-iron at the prices now ruling. At present, with an exception here and there, manufacturers report a very limited inquiry, and confess that their quotations are weak. Foundry iron is not quite so depressed as forge, for which there is a very limited call indeed, but there is no satisfaction to be obtained from either of them. Were it not that some foundry iron is still being exported, conditions would be precarious. Quotations:—Northamptonshire No. 3 foundry, 95s.; Derbyshire No. 3 foundry, 97s. 6d., all net, f.o.t. furnaces.

SCOTLAND.—Conditions in the Scottish pig-iron industry continue in a state of depression, inquiries both on home and shipment account being still very limited. The position of smelters will be further adversely affected in view of the official intimation that wages in the pig-iron trade in Scotland will be increased by 10 per cent. on basis rates, as the result of the average net selling price of Scotch iron having come out at £5 10s. 2.2d. for the quarter ending June 30. The price of No. 3 Scotch may now be called £5 6s. 6d. f.o.t. furnaces, equal to £5 9s. at Grahamston, which is practically the same as No. 3 Middlesbrough, whilst No. 4 foundry Middlesbrough is 5s. per ton less. There have been a few orders of moderate tonnage placed by Falkirk consumers recently, but a policy of hand-to-mouth buying is still in force. No. 3 Continental is on offer at £5 5s. at Falkirk, and there is a tendency for this price to stiffen owing to increased cost of raw materials.

Finished Iron.

At Birmingham last week, attendance at the weekly market was limited in numbers with business transacted in finished material on a corresponding scale. The position of the market-bar houses is still sufficiently good to enable them to maintain their basis, but concerning from every other branch the reports are most discouraging. Apart altogether from the holidays, there is very little work being done. Apparently demand is insufficient to maintain even as little as 50 per cent. productive capacity in operation, taking the trade as a whole. One reason for this, of course, is the quantity of common iron bars coming in from abroad. Nut and bolt manufacturers are not very busy, but such requirements as they have are being supplied to a very large extent from the Continent. Nominally the quotation is still maintained, but sellers would not be at all firm if there were a chance of securing an order. Good crown iron also is very firm, but inferior qualities are in poor demand.

Steel.

For very obvious reasons, business in steel and its various products during the current week has been confined within the narrowest limits, with the tone of markets weak and hesitating. The activity of recent months has entirely vanished, and even soft basic steel is not now called for to any extent. Soft basic billets can be bought at £8 10s. or less, but intermediate and hard qualities remain at £10 and £10 5s. respectively. Acid billets are little inquired for, and the price has been reduced 10s., making the basis price £12 10s. per ton delivered. This is the first reduction this year in acid steel billets. Makers of alloy steels report a little improvement. The heavier trade still report a great dearth of new business, with pessimistic views as to the future; but crucible and superfine steels are better, and there appears to be slowly increasing demand for high-speed steel. In this latter connection it is gratifying to learn that some very satisfactory business is being done with the United States, despite highly prohibitive import tariffs, and that Sheffield can more than hold its own when quality is the essential feature of the product. Business done in ferro-alloys during the week covers the whole field, but on the domestic side is not so brisk in the bulk alloys used in connection with the heavy trades. Ferro-manganese prices for domestic consumption are maintained, but orders are scarce both here as well as in America, and prices for export have been reduced 30s. Continental inquiry is quieter. The general tone of the tinplate market is rather better, due largely to the fact that manufacturers have agreed that the present minimum selling price of 23s. 1½d. basis for cokes, f.o.b. Wales, should remain in force until the end of September. The only alteration made was in the prices of oilsize wasters, which were reduced to 21s. 1½d. and 29s. 3d. as the minimum figures f.o.b. for 14 x 18¾ and 20 x 10 respectively.

Scrap.

The persistent decline in pig-iron values is having a similarly depressing effect upon prices in the scrap material markets, and with business continuing on a very limited scale, the general position in the trade has further weakened. In Lancashire it is, however, doubtful, notwithstanding the drop in pig-iron prices, whether the local ironfounders will begin to buy anything beyond the tonnage wanted for immediate use. It may perhaps lead users to expect lower prices when they buy, and will make selling more difficult even than it is at present when foundry scrap is quoted from 80s. to 85s. Hence dealers are disinclined to increase their stocks, and there is very little business being done in the cast-scrap market. A certain number of sales of cast-iron scrap have been reported recently in Scotland, but the quantities involved are small. There is really no demand for any class of cast-iron scrap, and, taking this into account with the further easiness in the prices of pig-iron, there is every likelihood of values experiencing further weakness. Heavy machinery metal and scrap railway chairs run about 90s. per ton, ordinary heavy cast-iron scrap about 80s. to 82s. 6d., and light metal and furnace firebars 65s. per ton.

XUM

Metals.

Copper.—Owing perhaps more to seasonal causes than otherwise, standard copper values have been irregular of late, but the fluctuations, as a rule, have been confined within reasonably narrow limits, without indications of inherent weakness. There is little change in the general situation, the market at the moment being practically at a standstill. The general demand has been much quieter, operators hesitating to enter into any important new commitments at the moment. Anything in the nature of a broadening demand for the metal in the event of a clearing of the political troubles would probably influence sentiment, but as there is plenty of standard copper lying in home warehouses, withdrawals may not have much effect on the market. Current quotations :—*Cash* : Thursday, £64 5s. ; Friday, £64 10s. ; Tuesday, £64 17s. 6d. ; Wednesday, £64 12s. 6d. *Three Months* : Thursday, £65 ; Friday, £65 5s. ; Tuesday, £65 10s. ; Wednesday, £65 7s. 6d.

Tin.—Some decline in consumptive demand, not unusual at this period of the year, has been doubtless responsible for lack of interest in standard tin during the past week and values consequently have evidenced a lower tendency. The outlook in foreign political conditions has also had a restraining effect upon buying movements, while sales reported in the East have again been only moderate (600 tons), but shipments thence are still estimated at 5,000 to 5,500 tons. Cables from Hongkong report that the market there, whilst firm, is very quiet owing to lack of supplies from the Yunnan. A small business was reported to have been transacted earlier at a price well above the standard parity. Shipments from Hongkong during July are as follows :—To United States of America, 175 tons ; to China, 285 tons. Stocks would appear to be still diminishing, and are reported to amount to only about 300 tons in Hongkong, whilst a similar quantity is said to exist in the Yunnan. Current quotations :—*Cash* : Thursday, £182 5s. ; Friday, £181 7s. 6d. ; Tuesday, £181 15s. ; Wednesday, £184 10s. *Three Months* : Thursday, £183 5s. ; Friday, £182 7s. 6d. ; Tuesday, £182 15s. ; Wednesday, £185.

Spelter.—Business in this metal of late has shown increased activity and market indications would certainly point to a general improvement in demand for consumption. Rudolf Wolff & Co. report that with a much improved demand for galvanised sheets consumers have bought spelter more freely, and quite a large business has been transacted, most of which has been for forward delivery. The advance in price has induced Continental producers to sell with a little more freedom, though there has been no anxiety to press sales. Current quotations :—*Ordinary* : Thursday, £30 17s. 6d. ; Friday, £31 5s. ; Tuesday, £31 5s. ; Wednesday, £31 12s. 6d.

Lead.—With good soft foreign lead (near dates) at £24 7s. 6d., values are now very difficult to maintain, though owing to the hold-up of supplies in consequence of the dockers' strike, near metal at one time commanded a premium of 5s. A further adverse factor in the position was the arrival of further supplies in the Port of London, coupled with the fact that additional consignments of Mexican lead are expected shortly. The demand from the consuming trades has not been particularly brisk of late, so that with the strike settled, and imports unfettered, there is every indication that prices will follow a retrograde movement in the near future. Current quotations : *Soft foreign (prompt)* : Thursday, £24 2s. 6d. ; Friday, £24 ; Tuesday, £24 ; Wednesday, £24 2s. 6d.

Hirst, Ibbetson & Taylor, Limited, have removed to 7a, Blackfriars Street, Manchester.

Macleod & Company, iron ore merchants, have removed from 142, to 41, St. Vincent Street, Glasgow.

The imports of foreign iron ore at the Senhouse dock at Maryport last week amounted to 15,280 tons.

St. Helens Cable & Rubber Company, Limited, have removed their staff from Warrington to the new works at Slough.

The Hodbarrow iron ore mines at Millom, Cumberland, closed down on Saturday last in consequence of the depression in trade.

The wages regulated by the sliding scale under the Midland Iron and Steel Wages Board were advanced 7½ per cent. from Monday, August 6, to Saturday, October 6.

At a series of meetings held in London of the various holders in the Sheffield Steel Products, Limited, on August 3, the voting was overwhelmingly in favour of a scheme for the reorganisation of the company.

Company News.

H. & C. Grayson, Limited.—No dividend on preference shares.

Magnus & Company, Limited.—Capital £10,000 in £10 shares. Metal merchants.

Rushden & District Electric Supply Company, Limited.—Interim dividend, 3½ per cent.

Clyde Valley Electrical Power Company, Limited.—Interim dividend on ordinary capital, 3 per cent. actual.

Renfield Engineering & Trading Company, Limited, 47, Renfrew Lane, Glasgow.—Capital £100 in £1 shares.

Industrial Steels, Limited.—Loss for year, £109,298 ; formation expenses written off, £12,042 ; total, £121,340.

Saws, Limited, Argyle Street, Glasgow.—Capital £2,000 in 1,000 preference and 1,000 ordinary shares of £1 each.

J. M'Bain & Company, Limited, Bridgwater Chambers, 6, Brown Street, Manchester.—Capital £5,000 in £1 shares. Engineers.

Midland Screw Products, Limited, The Saltisford, Warwick.—Capital £2,000 in £1 shares. Directors : J. K. Enoch and P. D. Enoch.

Electrical Distribution of Yorkshire, Limited.—Interim dividend, 7 per cent. per annum (free of tax) for six months ended June 30.

Gwent Pipe and Firebrick Company, Limited, Pontnewydd, Mon.—Capital £5,000 in £1 shares, to acquire the Pontnewydd Tinworks at Pontnewydd, Mon. Secretary : H. A. Taylor.

Bristol Tramways & Carriage Company, Limited.—Interim dividend for the half-year ended June 30, 3 per cent., less tax, on ordinary shares.

Emscote Foundry Company, Limited, 235, Westminster Bridge Road, London, S.E.—Capital £3,000 in £1 shares. Directors : O. H. Kempton and W. Bissell.

Gardner & Pederson, Limited, 2a, Albert Street, Fleetwood.—Capital £1,100 in £1 shares. Electricians. Directors : W. C. Gardner, P. McCreevy, O. Pederson, and A. E. Johnstone.

Hughes-Johnson Stampings, Limited.—Brought forward, £5,877 ; profits, £50,433 ; reserve, £25,000 ; final dividend, 5 per cent., making 10 per cent. for year ; carry forward, £2,933.

Westminster Electric Supply Company, Limited.—Interim dividend, 4s. 6d. per share (or 4½ per cent. actual), less tax, for the half-year ended June 30, payable on September 1.

Petersfield Electric Light and Power Company, Limited, 27, Lavant Street, Petersfield, Hants.—Capital £20,000 in £1 shares (6,500 6 per cent. preference and 3,500 ordinary).

Wm. Beardmore & Company, Limited.—Profit, £96,167 ; brought forward, £752,797 ; dividend on 6 per cent. preference, £86,400 ; carried forward, £762,564. No dividend on ordinary.

Garnett, Whiteley & Company, Limited, Lotus Works, Broadgreen Road, Liverpool.—Capital £5,000. Mechanical and consulting engineers, etc. Directors : G. Garnett, W. Garnett, and E. Whiteley.

Kirkland Iron Ore Company, Limited, Bank Chambers, Lowther Street, Whitehaven.—Capital £5,000 in £1 shares. Directors : F. Watson (chairman), E. L. Tosh, and M. F. Burnyeat.

John Gibbs & Son, Limited, 72, Duke Street, Liverpool.—Capital £5,500 in £1 shares (500 6 per cent. non-cumulative preference). Engineers, etc. Directors : J. W. Gibbs, J. L. Gibbs (chairman), and R. Lowe.

W. G. Prosser & Company, Limited.—Capital £3,000 in £1 shares, to acquire the business of electric welders and general engineers, carried on at Bowesfield, Stockton, as W. G. Prosser & Company. Directors : W. G. Prosser, Rose Cottage, Greatham, Stockton, and S. Machin.

Pattison's Combustion Product Plant, Limited.—Capital £15,000 in 12,000 6 per cent. cumulative participating preference shares of £1 and 30,000 ordinary of 2s. Directors : J. H. Howell, A. E. Turner, A. M. Ingledew, C. M. Pattison, A. Henton, and H. P. Simpson, 9-11, Fenchurch Avenue, London, E.C.

Yorkshire Electric Power Company, Limited—Interim dividend, 6 per cent. per annum for six months on shares issued prior to 1923 ; interim dividend on 250,000 new ordinary shares calculated to June 30, 1923, from date of allotment and first due date of instalment on amounts due and paid (excluding premium) on those dates.

Hawthorns & Company, Limited.—Report for two years ended December last : Brought forward, £31,339 ; transferred from income tax and excess profits duty reserve account, £21,635 ; Admiralty suspense account, £1,233 ; depreciation for 1920, 1921, and 1922, £30,876 ; written off investments, £11,994 ; off new capital issue expenses account, £6,871 ; discount on mortgage debenture stock, £2,130 ; debit balance, £33,786, carried forward.

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ESTABLISHED 1863.

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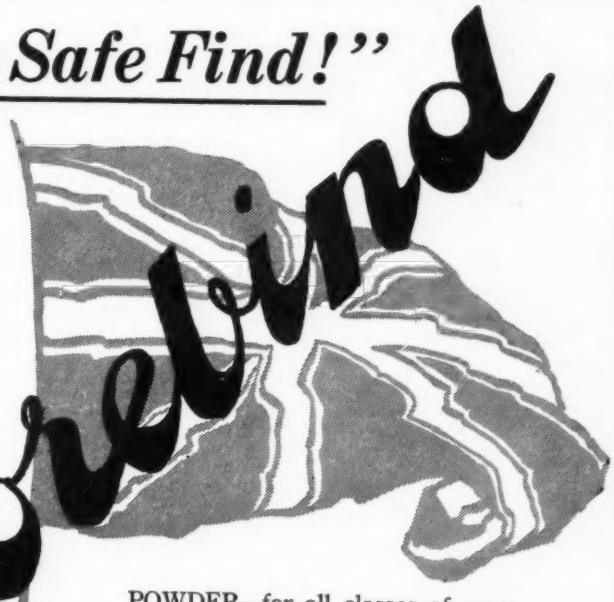

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Trade Talk.

THE DETROIT ENGINE COMPANY, Market Place, Brentford, Middlesex, have acquired the Fairbanks Company's interest in the sale of Bull-dog oil engines.

DURING JULY, eight cargoes of iron ore arrived at Maryport, all for the United Steel Companies, Limited, at Workington, the quantity amounting to 30,780 tons, against 10,000 for June, and 4,000 tons at the corresponding period of last year.

AT THE PRESENT MOMENT Whitehall and Parliament Street, London, are being reconstructed. The old concrete foundation is being replaced by 9 in. of reinforced concrete, B.R.C. fabric being the reinforcement selected.

OF THE 505 VESSELS totally lost, condemned, etc., during 1922, 217 of 344,133 tons were constructed of steel, 40 of 31,621 tons of iron, and 3 of 8,643 of ferro-concrete, and 245 of 132,314 were made of wood and composite.

MR. B. KELLY will conduct a course of lectures on iron and steel at the City of London College, White Street, Moorfields, E.C.2, arranged specially for those engaged in the export trade. The course will begin on September 25.

SOME 500 STEEL WORKERS struck work at the Albion Works, Briton Ferry, last week, and refused to return unless one of the workmen discharged for inefficiency was reinstated, to which the management would not consent. The men have since resumed.

THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH has been allocated £5,000 by the Government for the preparation of an exhibit of British Science at the British Empire Exhibition at Wembley next year, to be organised by the Committee of the Royal Society.

AN IMPORTANT DEVELOPMENT is foreshadowed in the Shrewsbury district, where a large North of England firm intend establishing an extensive works on the outskirts of the borough, for which purpose they have secured a large tract of land extending to upwards of 300 acres.

THE JOINT WELSH STEEL BOARD at Swansea have decided to grant shunters, engaged in steel works, an advance of 20 per cent., and loco-men 15 to 18 per cent., in addition to 5 per cent. on the last steel price ascertainment. This agreement fixes a uniform rate for these sections on a basis of 8s. a day for drivers, and 7s. shunters.

THE VICTORIAN STATE RAILWAYS COMMISSIONERS have placed orders with Elder, Smith & Company, Adelaide, for 4,887 tons of steel rails and 138 tons of fishplates, to be made by Bolckow, Vaughan & Company, Limited, of Middlesbrough, at the following prices:—Rails, 80 lbs., £8 18s. 8d.; 100 lbs. ditto, £8 18s. 8d.; 100 lbs. sorbitically treated, £10 14s. 8d.; fishplates for 80 lbs. and 100 lbs. rails, £28 18s. 8d. per ton; all c.i.f. Melbourne.

THE AVERAGE net selling price of Scottish manufactured iron for May and June has been returned as £12 2s. 4.5d. Therefore, there will be an increase in the wages of the workmen of 10 per cent. on basis rates. In regard to pig-iron for April, May and June has been brought out at £5 10s. 2.2d. This means that there will be an increase in the wages of the workmen of 10 per cent. on basis rates.

THE RETURNS OF tonnage launched from the Clyde shipyards during July are among the smallest ever recorded. Five vessels, with a total tonnage of 754, including a 700-ton dredger, were launched. The total output for the seven months of the year was 63 vessels, of 146,411 tons, compared with 73 of 200,454 tons at the corresponding date last year. Comparatively few new orders during the month are reported.

THE AUSTRALIAN COMMONWEALTH POST AND TELEGRAPH DEPARTMENT has placed the following tenders with Connollys (Blackley), Limited, Manchester:—Switchboard cable S. and C. insulated per mile: Item 1, 20,146 yards, £309 2s. 6d.; Item 2, 12.095 yards, £145 15s. 3d.; Item 3, 2,330 yards, £270 16s.; Item 4, 2.080 yards. £236 7s. 6d.; Item 5, 11.635 yards, £208; Item 6, 5.870 yards, £150 11s. 6d.; Item 8, 29,990 yards, £125 15s. Total contract, £9,195 10s. 7d.

AT A MEETING of the Buckley Urban Council recently a deputation was present to discuss with the Council the question of the provision of Public Baths. The deputation, which consisted of Messrs. W. C. Collins (manager), R. Hewitt, B. Piercy and W. H. Iball, defined the case for the Miners' Welfare Committee, and mentioned that the Miners' Welfare Fund had offered Buckley a sum of £1,500, the Council to find another £1,500. It was stated that the miners could if they wished have the £1,500 and adopt a scheme which would be confined solely to miners, but they wanted a scheme which would benefit the whole neighbourhood. It was eventually decided that the site suggested be adopted subject to a sufficient water supply being secured.

Personal.

MR. F. R. DAVENPORT has joined the board of the Brush Electrical Engineering Company, Limited.

DR. PERCY LONGMUIR has, we understand, resigned his position as director of the British Cast Iron Research Association.

MR. GRANT BARCLAY, managing director of the Caledon Shipbuilding & Engineering Company, Limited, has been appointed a Deputy-Lieutenant of the County of the City of Dundee.

SIR WILLIAM PEAT, who retired from the firm of W. B. Peat & Company, Limited, on June 30 last, has been elected a director of the National Provincial and Union Bank of England.

SIR WILLIAM J. LARKE, a Director of the National Federation of Iron and Steel Manufacturers, was on the broadcasting programme in the London area recently, under the heading, "Men's Talk," the subject being "Iron and Steel."

MR. H. M. TODD, who has held appointments among others with the British Westinghouse Brake Company, Limited, and the British Thomson-Houston Company, Limited, has established himself in business as an electrical power engineer at 12, Harvie Street, Glasgow.

Gazette.

T. C. MATHEW, engineer, 171, Stafford Road, Wallington, is paying a first and final dividend of 7¼d., at the Official Receiver's office, 29, Russell Square, W.C., August 13.

IRONCLAD SWITCHGEAR COMPANY, LIMITED, are being wound up voluntarily, with Mr. W. P. Masterson, Bank of England Chambers, Tib Lane, Manchester, as liquidator.

THE APPLICATION FOR DISCHARGE from bankruptcy proceedings by T. Roberts and L. E. Hibbs, trading as Roberts & Hibbs, Bank Street Works, Bank Street, Fairfield Road, Droylsden, engineers and ironfounders, has been granted.

TRADING UNDER THE STYLE of the Reliance Pattern and Metal Company, Messrs. R. G. Mottram and S. Higginbottom, Victory Works, Raven Street, Pendleton, Manchester, engineers and general wood-workers, have dissolved partnership. Mr. R. G. Mottram continues the business.

THE FIRM OF Dunsmuir & Jackson, engineers, Clydeside, have decided to go into voluntary liquidation. The firm have all along been a private concern, and it is stated that the decision to wind up is for purely private reasons. The firm, whose works are at Windsor Street, Govan, are one of the best known of Clyde marine engineering companies. They specialise in the construction of reciprocating engines, mainly for cargo steamers built on Clyde and elsewhere. Last year they supplied machinery of this type aggregating 19,000 i.h.p. for six vessels.

THE STATUTORY FIRST MEETINGS of creditors and shareholders of White Brothers, Limited, of Itchen, Southampton, yacht builders and ship-repairers, have been held at the London Bankruptcy Court. The Official Receiver reported that the statement of affairs showed total liabilities of £243,613, of which £156,121 ranked for dividend, against assets of £16,258, and a total deficiency as regards shareholders of £179,197. Resolutions were passed for the nomination of Mr. F. W. Lord, 37, Walbrook, London, E.C., as liquidator.

Obituary.

MR. ALFRED BROWN, iron and steel merchant, of 9, Lawson Street, Barrow-in-Furness, died recently in his 66th year.

MR. ROLAND BEARD, Mossend, works manager of the Milnwood Works of Smith & M'Lean, Limited, died on Thursday, August 2. Mr. Beard, who was in his 58th year, and a native of Staffordshire, had spent most of his life in the Clydesdale district. He first entered the Gartcosh Works of the company, and about 28 years ago went to the Milnwood Works in the capacity of works manager.

MR. MARK MORDEY, one of the pioneers of the shipbuilding and ship repairing industry in the Bristol Channel, died recently at Newport, aged 74. He served an apprenticeship as a shipwright, and later, with Mr. J. H. Carney, he founded the firm of Mordey, Carney & Company, ship repairers and dry dock owners, which has works in various Bristol Channel ports and at Southampton.

MR. E. J. CHRISTIAN has been appointed general manager and elected a director of Sutcliffe Bros. & Bryce, Limited, of Hyde, manufacturers of asbestos for lagging, etc.